NOVEMBER 23, 1935

ELECTRICAL WORLD

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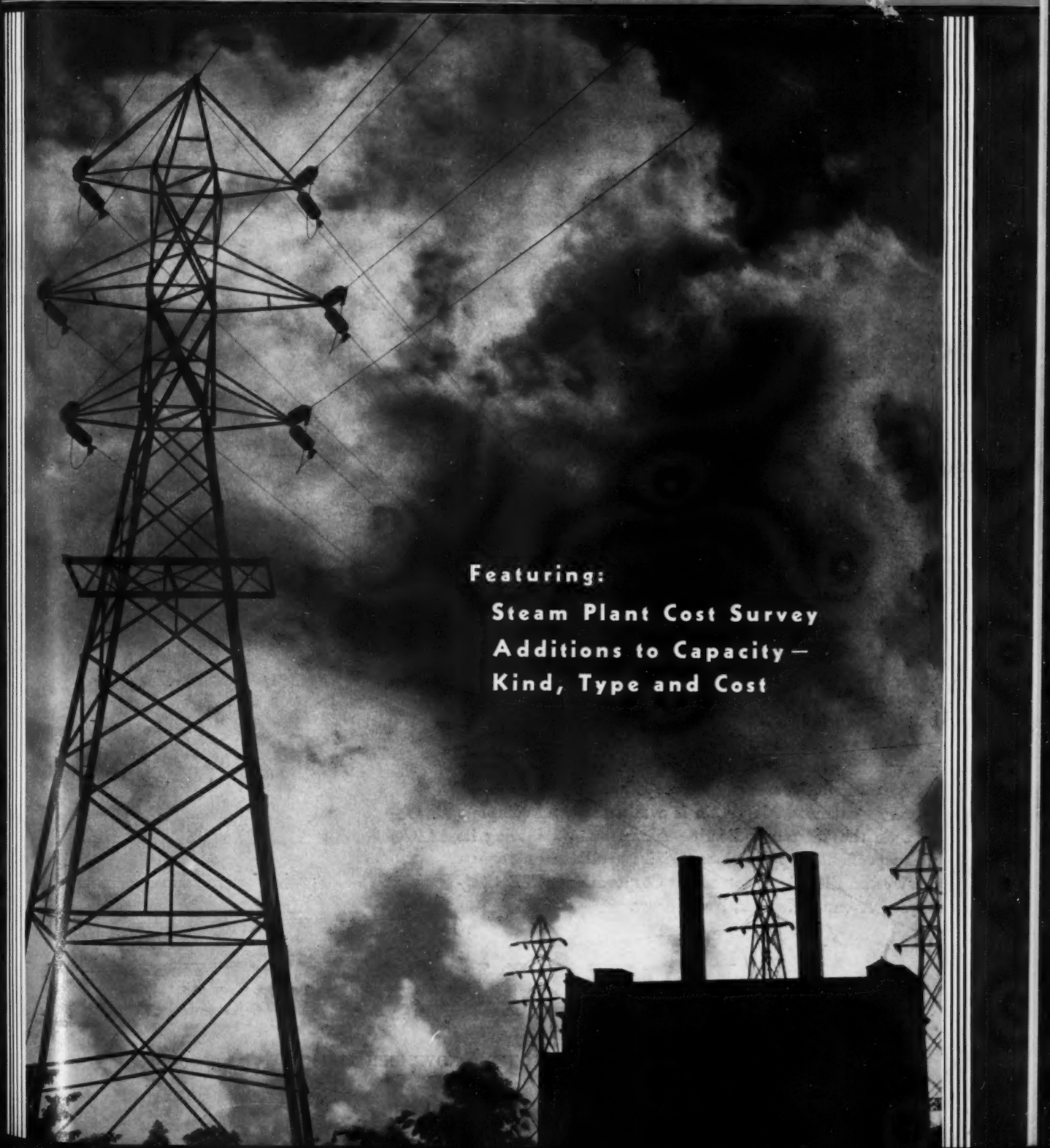

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Reader's Guide to This Issue

This index is merely a convenient guide. Many articles will appeal to several reader groups—many will apply to all. News and other departments are of general interest.

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LETTERS TO THE EDITOR

Frank Comments On Lighting Business

To the Editor of ELECTRICAL WORLD:

A few weeks ago, when an issue of ELECTRICAL WORLD came, my attention was caught immediately by a title, "Sales Mount in Georgia," of an article prepared by you. Eagerly I turned the pages to locate this article, thinking that here I would find ammunition to assist us in convincing other utilities that they should go into the lighting activities with somewhat equal enthusiasm and facilities to those used by the Georgia Power Company.

Hastily I scanned the three pages of the article for statements of results in connection with the company's lighting activity, for I knew that it had done an outstanding job. I learned a great deal about allowances for old ranges, etc., all of it pertaining to appliances, and I was forced to the conclusion that both the author of the article and those who gave him the information were convinced that the appliance sales activity had been tremendously successful. A few words, here and there, suggested that they had also had a lighting activity which may have contributed in some degree to the total.

Then I analyzed the article more carefully and discovered the details in the table at the bottom of page 33, where I found that the added annual kilowatt-hours due to home-lighting calls and home-lighting lecture demonstrations constituted 40 per cent of the total added load, and I decided to write you and ask why it is that so many utility executives and writers refuse to recognize the important place that residence lighting has in the development of a most profitable revenue, in spite of such statistics as appear in this article. The result would suggest that 40 per cent perhaps of the article might have been devoted to pointing out how the results in lighting were obtained, instead of perhaps less than 1 per cent. That 1 per cent which did appear contained no information that would be helpful to any other executive. Having met you personally in Mr. Harrison's home at the time of the Case School conference, I felt that I should ask you this question, not in the spirit of criticism, but in the hope that I might have the real answer given to me.

It seems to me that the lighting program we have prepared, requiring very little but man-power and producing remarkable results wherever given a fair trial, should sweep the country—that no utility could afford to be without a trained personnel in home lighting sufficient to contact all of its meters in a relatively short time and then contact them again and again. But we are continually confronted, not with indifference, but with a more glorified conception of the importance of appliance sales, an activity requiring investment both on the part of the utility and of the consumer of much greater magnitude than required for lighting.

It is only fair to say that I am carrying the issue of July 6 with me and have used it very effectively in a number of places. I remark enthusiastically about the fine thing which the Georgia Power Company has done and show them the article, letting them find that appliances are responsible for virtually all the results, and then I accuse them of being just like all the rest and I show them the table, suggesting that they really look into the matter and not only give lighting the credit which is its due but also organize to get the load and revenue to which they are clearly entitled in the lighting field.

I shall appreciate very much learning from you what you consider to be the reason for this attitude, which seems to be all too prevalent, in spite of established results.

L. V. JAMES,
General Electric Co.
Chicago.

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True Cost of Power

To the Editor of ELECTRICAL WORLD:

In your October 12, 1935, number, on page 42, under the head of Trends, is an article "Cost of Power." The last two sentences are as follows: "This address shows the great importance of bringing out the facts under the topic 'National Power Economy' at the World Power Conference next fall. The truth about power costs should and will prevail."

I hope whoever writes the articles on this subject will endeavor to confine his statements to facts, and not cover them up with propaganda. We've had altogether too much of it in Canada, the T.V.A., municipal plants and private or public utility plants. It will be a pleasure to have some one who has ability and knowledge write the facts as they really are and as they will be later when the cost of fuel in many parts of the United States goes up. All costs—capital, interest, fuel, administration and replacement —should certainly be set out in great detail.

LOUIS C. HILL,
Los Angeles, Calif.

Feels British Cable Practice Is Superior

To the Editor of ELECTRICAL WORLD:

One of the editorials in your issue of September 14 refers to the corrosion of underground cables, and this item, together with some recently obtained information as to American practice in trailing cables, leads me to write you.

In regard to trailing cables, the cab tyre sheathed type was brought out in England in 1910, and in a couple of years time it had become the standard British type, displacing the braided, armored, leather-sheathed and various other types of protection on account of its much greater efficiency, safety and length of life. In America, however, rubber-sheathed trailing cables seem to have been very little used until the early 1920's, about ten years later, during which period users had to put up with the troubles caused by the above-mentioned cheaper types.

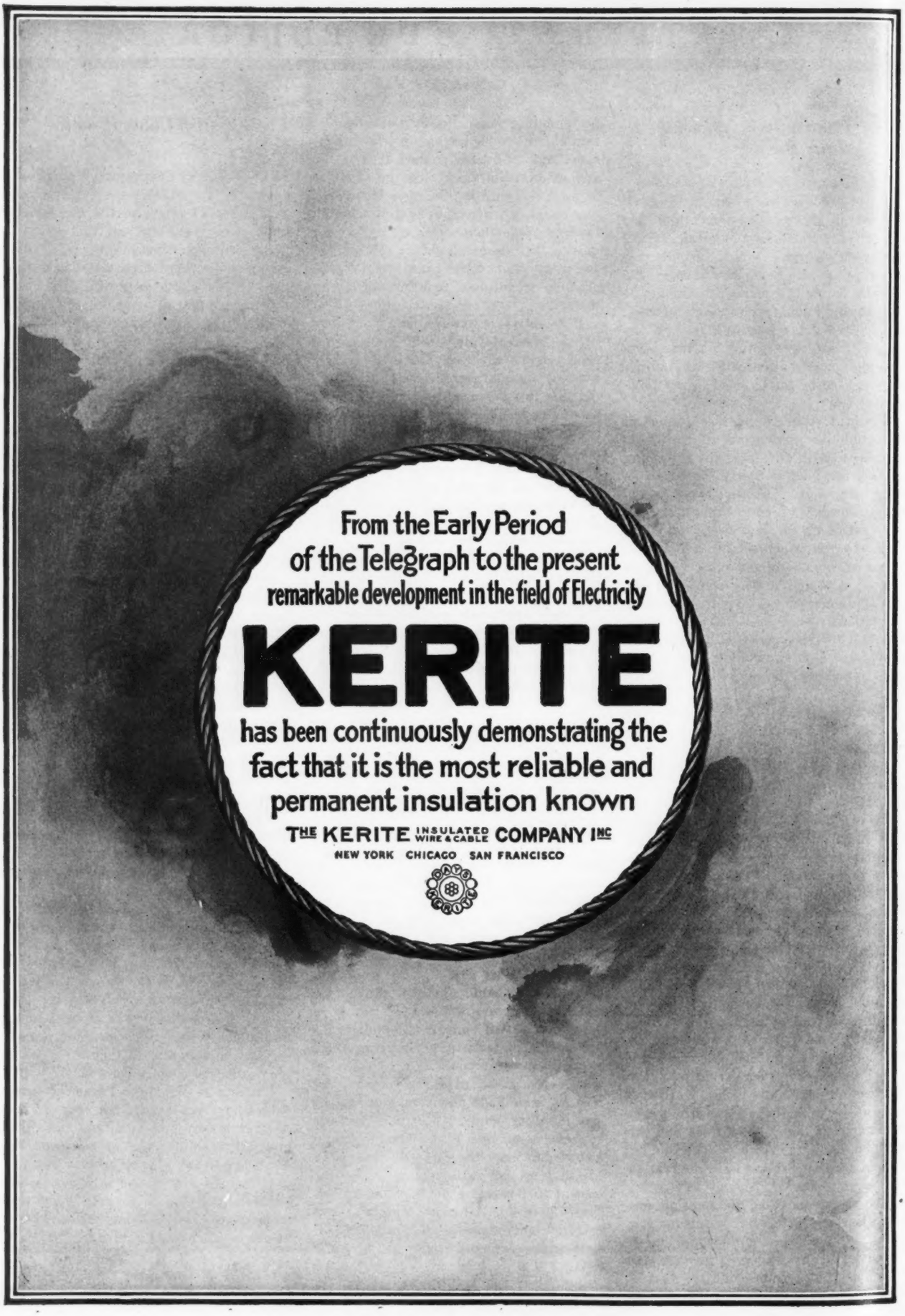
Another matter in which England appears to be ahead of America is the latter's inability to produce a corrosion-proof cable sheathing to compare with the "Pernax" sheathing that is so largely used in the United Kingdom. The extent of corrosion in the U. S. A., according to details published in your journal, shows that corrosion on lead sheaths is about 20 per cent of the total number of cable failures. In England the proportion is nothing like so high and it may be due to the fact that wherever corrosion causes trouble, or is likely to cause trouble, the cables are Pernax sheathed, which gets over the difficulty. More than 100,000 yards of such sheathed cables are in use in the U. K., mostly being laid under the most severe conditions of corrosion.

I understand that American practice is to use wrappings and servings of various materials, such as bitumen, tar, wax, oil, asphalt, etc., which may be waterproof in themselves, but are not so when allied to the fabric tapes with which they are used. The U. K. some time ago recognized the limitations of such impregnated tapes and servings and now uses them only where the chances of corrosion are slight.

I may add that these Pernax-sheathed cables have been under the practical test of severely corrosive conditions since 1930 and not a single case of corrosion has happened to any of such protected cables.

If there is any system in America that can compare with this record, I am sure cable users on both sides of the Atlantic would be glad to hear of it.

J. H. C. BROOKING,
Managing Director
Croydon Cable Works, Ltd.
Croydon, England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MANAGEMENT • ENGINEERING • OPERATION • UTILIZATION

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NOVEMBER 23, 1935

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No Rocks in the Road Ahead

MANY talks with leading manufacturers and utility executives about the outlook for business bring out one conclusion. For the next twelve months there is nothing in sight to stop a steady increase in business in this country, and the electrical industry is in a favored position. However disturbed by the New Deal some of these men may be, they admit this fact and arrive at this conclusion. Electrical manufacturers are basing budgets on this belief. Incomplete reports indicate an expectation of at least a 30 per cent increase in electrical product sales next year. Some anticipate almost a boom market and are increasing inventories rapidly in order to supply the demand. Utility load increases plus the decision of Judge Coleman mark a turning point in this business. The attitude has changed and the skies are clearing. There is solid ground for hope and optimism. This opinion about the business outlook should get political reassurance from the recent statement of Mr. Roper that the "breathing spell" would be extended indefinitely.

•

Utilities at the Judgment Seat

GROSSLY arbitrary, unreasonable and capricious are the strong words used by Federal District Judge Coleman in holding the 1935 Public Utility Act invalid in its entirety. This ruling sustains the position taken by the utilities completely. The sweeping decision gives encouragement to the industry and augurs well for the coming Supreme Court decision on appeal. In the meantime, a major utility question is to register or not to register with S.E.C. Opinions differ. Lawyers and executives in utility ranks are pondering the situation. S.E.C. is releasing persuasive and reassuring words. If rights are waived by registration, this should not be done.

As pointed out by Mr. Gadsden, there can be no criticism of the appeal of the utilities to the judiciary when this destructive and unconstitutional legislation was passed. It should be clearly understood that the utilities are not fighting fair regulation; on the contrary, they welcome it and would help develop it. But they must use every possible method for obtaining constitutional protection against the present confiscatory legislation. The decision whether or not to register is not a matter of stubbornness or obstinacy. It is a matter of legal procedure by an industry that is battling for its life.

•

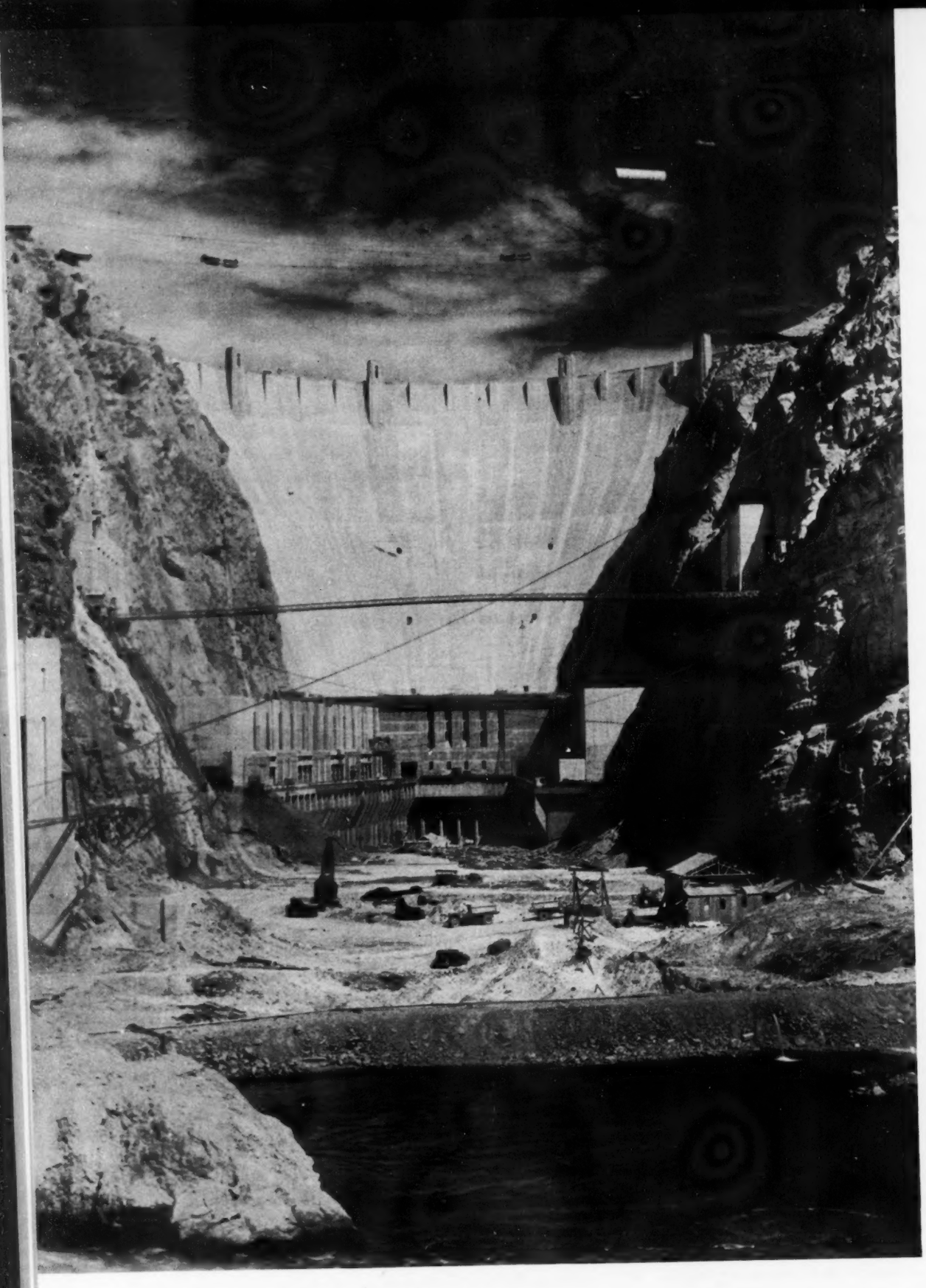
What to Do About It

A VAST silence seems to prevail since Congress adjourned. At least as regards the mouthings of the politicians about the utility business. Can it be that they are listening instead of talking, particularly since the recent election recorded jolting jars from tax-conscious citizens? We are glad of this lull in damnation and denunciation. We are happy that the politicians returned home and ceased to be mouthpieces for enemies of the industry. As they sit around the corner stores they will find that the utility situation does not interest their consituents. It is the A.A.A. with its corn, hogs and potatoes. It is the P.W.A. with its spending. It is the growing cost of living and the consciousness that somebody must pay a tax bill that disturbs the local citizens. It's just too bad that facts will not support their former foghorn utility clamor. May they "gladly learn" and "gladly teach."

•

More Loads Call for More Capacity

REVIVAL in power station building is under way. Many turbines are under negotiation. American Gas & Electric has ordered a record unit, rated 40,000 kw., 1,250 lb., 925 deg. and 3,600 r.p.m.—an indication of the advance in the art during the depression. Capacity must be added to carry the record-breaking and ever-increasing loads coming on the utilities. For these reasons the articles in this issue, giving invaluable data on representative steam stations and suggestions for adding capacity, should be helpful to the industry.



BOULDER DAM POWER IS EXPECTED TO BE AVAILABLE IN LOS ANGELES NEXT SEPTEMBER

Additions to Steam Plant Capacity

Attention on Investment Cost Reduction—Ways and Means to Remodel Existing Stations and to Add to Their Capacity—New Developments in the Art and Where They Fit—Principles to Apply in Station Design

By FRANK S. CLARK
Consulting Engineer Stone & Webster Engineering Corporation

Boehrach

THE unwelcome "breathing spell" in power station construction activity appears to be nearing its end. Judging from the reports of electric power production, which have reached all-time peaks; from increasing requests for equipment prices and data, and from the findings of the ELECTRICAL WORLD editorial staff, we are approaching the time when engineering design, equipment deliveries and construction schedules must be coordinated to provide capacity in as quick time as is economically possible.

The pause in power capacity construction, however trying and unwelcome, has had its advantages. Experience has been gained with prior developments in the art, we have had time to study and appraise these properly; research, particularly in metallurgy, has progressed uninterruptedly, with the result that we should be better equipped for the problems that are to come.

The decade preceding the depression was one of consolidation of production facilities and of power-consuming groups. This has resulted in benefits to consumer and producer alike by making electric power available to a large number of scattered communities, and by decreased unit investment cost and greater economy of production. One has but to study the national map of transmission lines and interconnections to realize the degree to which consolidation of power production has proceeded and the probability that it will slow down for natural economic reasons without any possible braking action due to present legal complications. This does not mean, necessarily, a return to decentralized production according to the old accepted definition, but indicates a continued use and strengthening of interconnection and transmission facilities, a decreased number of new power station developments, and more capacity installed as increments to existing plants.

Four general methods to add capacity

In previous articles the author has stated that there are four general methods for providing additional system capacity and improving efficiency, which are:

1. Construct a new plant.
2. Extend an existing plant.

We asked Frank S. Clark to talk about additions to generating capacity in the utility industry because he knows the business and the art. He makes tangible suggestions for reducing costs, for improving operations and for remodeling existing stations. He tells of the new developments in equipment and shows where they fit into the economics of power supply. This is an outstanding article by an authority on steam stations.

3. Rehabilitation of an existing plant by changes in existing equipment, and in operating and maintenance methods.
4. Superposition of high-pressure boilers and non-condensing turbine generators on an existing lower pressure installation.

Any addition to or change in the power-producing facilities on a system involves a readjustment of power generation in the individual plants, with consequent changes in their load and capacity factors. This requires a careful study of increment production costs, which becomes more complicated as the number of plants increases. A clear understanding and analysis of this situation is essential and of its effects on the costs of production throughout the period of complete absorption of the added capacity.

When deciding upon capacity additions, executives and engineers will survey more closely fixed charges and operating costs, both separately and in their relation to each other. The possibilities of the present steam cycles with regard to efficiencies are pretty generally understood and are approaching their economic limits. It is to investment and other items of power costs that scrutiny is being turned.

An examination of past operating

records reveals the increased reliability of modern steam and electric generating units. The need for duplication and interconnection of auxiliary equipment has become less, which permits not only of using a lesser number of such apparatus but of simplification of steam piping and electrical connections. *The installation of one steam generating unit per turbine generator is now considered a reliable arrangement, reducing complication and conserving space.* It is perfectly possible also now to design and install additional capacity with the necessary points of operation at the same level. These, with the omission of interior partition walls and the use of automatic centralized control of equipment, effect an ease of operation with a minimum of personnel and materially decrease investment costs.

Higher temperatures safe to use

The knowledge gained through metallurgical research during the past five years is an aid to immediate and future developments in permitting the safe use of higher steam temperatures. The pioneer installation of the Detroit Edison Company in the use of 1,000 deg. F. steam has given confidence to the industry and some new installations will approach this limit, using the regenerative in place of the reheat cycle, thereby decreasing investment cost. *Due to the greater cost of equipment to operate at the higher steam conditions (1,200-1,400 lb. and 900 deg. F.) it is probable that the smaller installations will adopt a temperature of around 850 deg. F. and pressures of from 650 to 800 lb., unless continued high load factor operation and/or high cost of fuel can make the higher conditions justifiable.*

The foregoing remarks are applicable to each of the methods given for increasing system capacity. Other considerations may govern the decision as to which means is to be adopted and may eliminate automatically one or more of them. It is conceivable that complete utilization of space and facilities of a given site, or growth of load in a certain locality, may require or dictate the development at a new site. Almost certainly a new station will result in a greater investment per unit of capacity, as complete new facilities must be provided, including transmission or distribution. Generating unit size will be governed more by the capacity of previous largest unit than by actual growth of load requirements, resulting in a larger investment than if the unit were of a capacity that more nearly fits the load growth.

Studies of operating methods and conditions have revealed instances in which improvements can be made in production costs of existing plants with a capital expenditure sufficiently small to justify their being done. These include both operating and maintenance practices, and also minor changes in equipment. Ordinarily, these do not result in an appreciable gain in capacity, but may improve reliability.

Major rehabilitation measures, involving a greater capital outlay, but providing additional capacity at existing steam conditions, comprise rebuilding of existing turbine generator equipment and/or substituting more modern and efficient combustion equipment to produce greater steam generating capacity. Many older boilers have been limited in output by low rates of heat generation and the use of refractory furnace walls, either solid or air cooled. Substitution of water-cooled walls and modern combustion equipment permit higher rates of heat liberation and greater steam output. This latter method is particularly attractive in cases where there is an excess of electric generating capacity or where space exists for an additional turbine generator. In some cases a larger unit may replace a smaller one using the same condensing equipment. While such measures of rehabilitation may not effect great increases in operating efficiency, they are distinctly attractive from a capacity standpoint.

Superposition often economical

The superposition of higher pressure and temperature steam generating equipment and non-condensing turbine generators on existing plants is attracting widespread interest from operating company executives and engineers and from manufacturers. The idea is neither new nor novel, having been applied with satisfactory results in a number of cases. Its present attractiveness is due to the advances in allowable pressures and temperatures which permit of greater heat utilization in the superposed electric generating units. The subject is so varied in its scope and application that no offhand conclusions can be drawn as to its desirability. It is not the obvious answer to every problem of improvement or capacity addition, but must be compared with and studied in the same light as other methods available. *As a general rule, plants more than twenty-five years old are not adaptable to superposition because of obsolescence and inefficiency of turbine generating equipment and their auxiliaries, while those less than ten years of age do not offer themselves so readily for the reason that their higher steam pressures and better efficiencies reduce the capacity it is possible to add and the economies to obtain.*

Superposed pressures and temperatures considered at present lie within two ranges, from 650 to 800 lb. and from 1,200 to 1,400 lb. The lower range is considered adaptable to stations of relatively small capacity (30,000 kw. or less) and low steam pressures (200 lb.). The higher range is applicable to plants of larger size, at the lower pressures where maximum advantage can be taken of the increased heat range and capacity addition, and may possibly be made in some instances to prove economical for the higher pressure stations (up to 400 lb. pressure). It is practically impossible to make out a case for superposition where present pressures are in excess of 400 lb. Temperatures accompanying the 650 to 800 lb. condition vary between 800 and 850 deg. F. Those corresponding to the higher pressure are from 900 to 925 deg. F.

Due to differences in conditions in existing plants no definite statement as to unit investment costs of superposed installations can be made. The author believes that they will prove more economical in the great majority of instances than a new station and that capacity requirements rather than economy considerations will be the deciding factor, but whether it will prove more desirable than station extension will depend upon load characteristics, the size of the station and its vintage. Where space is available in present buildings costs will be less, the amount varying with the amount of structural adaptation required to suit the new equipment. This may be considerable in the case of boilers and their related accessory apparatus due to the great differences between old and modern equipment. If no structural changes are made compromises with the most desirable type and number of boiler equipment will almost certainly be necessary.

Superposition has usually the advantage of permitting capacity installations to be made more nearly in

accordance with load growth and at already established load centers, which latter it shares with a station extension. The result is less investment cost but with shorter intervals between capacity additions, until such time as the limit is reached of the capacity it is possible to add in this manner. Where available condensing water supply is restricted or has already been utilized superposition permits addition of capacity beyond the previous ultimate maximum.

Existing equipment has capacity and financial value varying with its state of obsolescence and independent of any depreciation reserve that may have been set up. This is particularly true of turbine equipment, which superposition affords a means of retaining after age and insurance requirements force reduction in boiler operating pressure. It permits also utilization of any existing turbine generators for which there is no steam generating capacity available.

Trend to high-speed units noted

Turbine generator units remain more or less conventional in design, although the requirements of higher temperatures may change shell construction and interior arrangement. There is a demand for 3,600-r.p.m. units in larger capacities, particularly in high-pressure superposed installations, which manufacturers will supply in sizes up to 62,500 kva. The use of the side outlet exhaust and vertical condensers permitted decreased height of foundation structures, and it would appear that the same exhaust arrangement, but with the condensers placed horizontally, has possibilities of increased ease of operation at no greater and possibly at less cost. *The higher steam pressures and temperatures that are being used, together with greater rates of steam generation, require careful attention to the treatment of feedwater and to the elimination of moisture carry-over in the steam to superheaters.* This is especially necessary in cases where the percentage of make-up is high. For this reason drums in modern boilers are made larger than formerly to furnish greater steam liberating surface and to permit the installation of baffles and eliminators.

Higher rates of combustion and of steam generation have brought about changes in furnace and boiler design, and equipment now contemplated differs radically from previously accepted designs. With pulverized coal firing the slag tap furnace bottom was adopted some years ago for use with coals having a relatively low fusion temperature of ash. Experience has demonstrated the superiority of a water-cooled bottom. Increased heat-liberating rates combined with directing the flame toward the slag bed has permitted the use of this type of bottom with coals having higher ash fusing temperatures, although troubles are encountered in keeping the ash liquid at reduced rates of evaporation. There are no great difficulties arising from this, if the cycle of operation permits increasing the rates of output at sufficiently short intervals to melt the slag for tapping. Modern furnace walls are completely water cooled, with a larger proportion of the steam generation occurring in the wall tubes.

Use of slag screens, consisting of tubes forming a part of the boiler heating surface, is common practice with both stoker and pulverized coal-fired boilers. High combustion rates, together with higher boiling temperatures, due to increased steam pressures, bring the so-called heat traps into greater prominence. Both economizers and air preheaters are now commonly used, many of the former being of the steaming type, while the latter are heating the combustion air to higher temperatures, particularly in cases where pulverized coal is used.

Difficulties in securing a reasonably uniform steam temperature throughout a sufficiently wide range of steam generation have caused attention to be given to superheaters. These are now placed nearer to the furnace proper, in many cases being exposed to the radiant heat and shielded by only a few rows of boiler tubes. *Control and constancy of superheated steam temperature are important from the standpoint of preventing the overheating of the tube metal and of maintaining efficiency in the turbine generating units.* Limiting the maximum temperature has been accomplished in some cases by dividing the superheater into two parts in series with a deheating device between the two, controlled by the temperature at the outlet from the second or higher temperature portion. Both control and limitation are accomplished in the later double-ended bent tube boilers of the Detroit Edison Company by a combination radiant and convection superheater, the latter being in two parts, one located in each half of the boiler. By suitable damper control the quantities of gases passing over the convection surfaces are varied to accomplish the result desired. By-pass dampers are now contemplated for installations of both straight tube and of single bent tube boilers which at high rates of steam output will divert a portion of the gases from the superheater surface into a back pass of the boiler or into the economizer.

Stokers and pulverized fuel

The author believes it to be true that with the present state of development of the combustion art greater rates of continuous steam generation are being obtained with pulverized coal firing than with stokers. In some cases these rates are maintained over long periods and boilers are kept "on the line" for periods of several months. In regard to this latter feature, however, the investigations of Messrs. Hirshfeld and Moran, as stated in their papers before two annual meetings of the American Society of Mechanical Engineers, show comparatively little difference between the two methods of firing, considering the average of a large number of boilers. The author believes also that greater latitudes in selecting maximum preheated air temperatures are permitted at present with pulverized coal firing. The development in a Midwestern plant of an underfeed stoker with water-cooled tuyères has met with success in increasing fuel-burning rates and permitting the use of higher air temperatures. An improved type of this stoker is being installed under a new boiler in this plant and is offered for use with the Eastern coals.

Automatic zoned control of air to

[*Continued on page 66*]

Principles to Follow

1. Reduce investment by using unit boiler - turbine - generators without duplicate auxiliary reserves.

2. Take advantage of high-pressure, high-temperature operating economy in new plants and in remodeling old plants where this is justified.

3. Utilize new equipment and new developments in the art in both old and new plants to reduce costs.

Banking Transformers Improves Service

Practice Reduces Voltage Flicker From Load Fluctuations, Improves Service Reliability and Provides Cost Economy

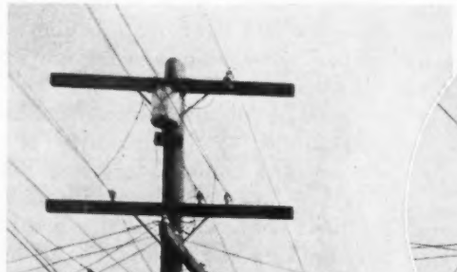
By M. T. CRAWFORD
General Superintendent Puget Sound Power & Light Company, Seattle

IN THE economics of distribution the main objective is to provide for the minimum of investment and operating expense, consistent with service dependability and good voltage regulation. In general, there are two schools of thought regarding the design of overhead distribution in urban residential areas, one preferring radial schemes and the other favoring the parallel operation or banking of transformers with more or less networking.

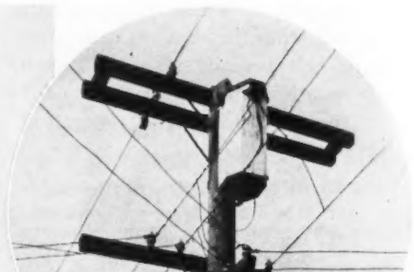
In many cities a strictly radial type of system is used with primary feeders extending radially from substations with branch lines tapping off and the wire size tapering down with the feeding distance. Distribution transformers are installed at intervals with secondary mains radiating therefrom, each feeding its own group of customer services within an economical radius.

Another type of design tends toward parallel operation of facilities with the distribution transformers banked together on secondary mains and operated in parallel over more or less extended areas. In some cases the interconnection idea is extended to include a grid network type of primary mains as well as a network of secondary mains.

In the strictly radial type of distribution there are certain advantages. Transformer troubles, particularly from lightning, may be cleared without a service interruption extending beyond the group of customers supplied from the transformer affected. If the design tapers the wire size properly and provides transformers of the right size an excellent voltage regulation may be maintained by means of substation regulators with line drop compensation, provided there is no material change in the location and character of the load.



Transformer poles on common neutral grid



(a) One-wire primary on top arm. Single transformer fuse. Note connection between second transformer terminal and secondary neutral wire passing under transformer.
(b) Arrangement on pole jointly occupied with telephone company.

On the other hand, engineers who have had experience with parallel operation have found that a correct design will usually clear damaged transformers without interrupting customers' service, and a properly designed network of primary and secondary mains will provide good voltage regulation under shifting load conditions and growth. Also, it can generally be shown to provide the best copper economy and minimum of distribution transformer investment as well as reducing voltage flicker from starting currents on refrigerator motors, oil burner motors, etc.

In Mr. DeMerit's article on progressive distribution, ELECTRICAL WORLD, April 27, 1935, it was shown that a radial type of distribution system can be designed so as to take care of progressive load growth quite economically by the installation of additional line transformers between primary and secondary mains, at the same time shifting the location of sectionalizing breakers in the secondary mains so as to maintain the radial features of distribution from each transformer. Where the sectionalizing breakers are omitted, however, and the distribution transformers operated in parallel on continuous secondary mains, a still further economy in taking care of progressive load growth can be effected by reason of the diversity factor between the maximum demand of individual groups of customers. Where residence connections with only lighting and small appliance load predominate there will be less realization of such economy as much of the diversity factor advantage can be obtained from

the number of such customers which would normally be supplied by a single transformer. Where, however, there is a considerable proportion of major appliances, particularly electric ranges and water heaters, a larger number of residence customers must be served in parallel before the full economy from diversity can be realized, and parallel operation is particularly adapted to distribution where such loads predominate.

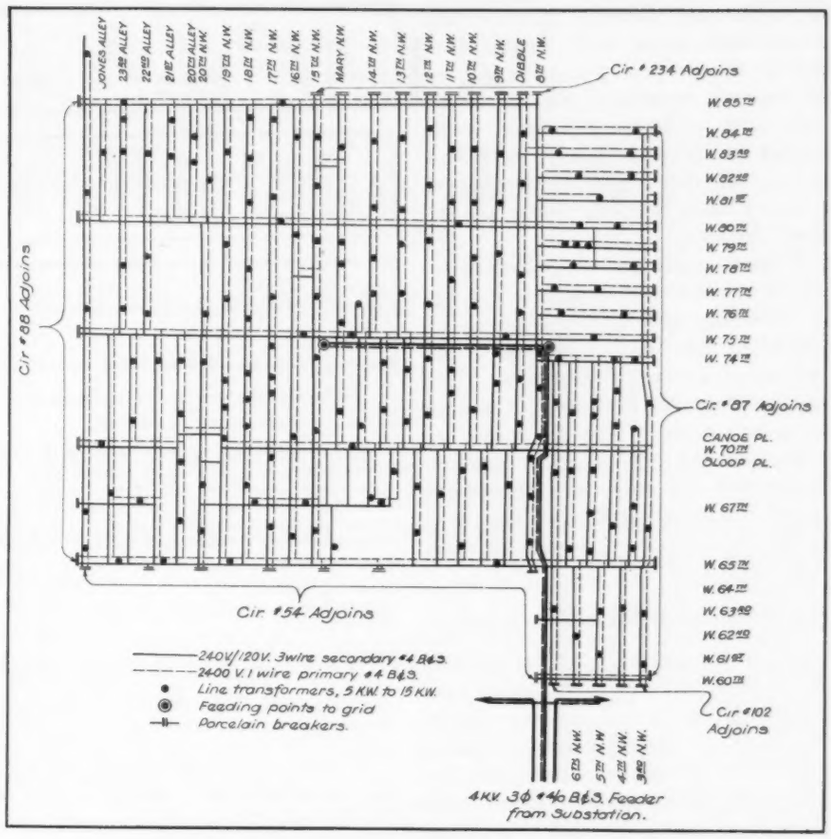
The flicker of lighting voltage due to suddenly applied loads is very objectionable, the exact tolerance depending on the frequency and quickness of the voltage flickers. Since there is always some drop in the customers' wiring and service, the voltage flicker at the service pole due to such loads should preferably be held within a few volts to be kept within fair limits of tolerance. Refrigerator motors, oil burner motors and washing machine motors are usually $\frac{1}{3}$ hp. or $\frac{1}{6}$ hp. rating, with starting currents on the order of 15 to 20 amp. For comparing radial with parallel operation the accompanying set-ups have been assumed in which the distribution requirements call for one 15-kva. distribution transformer every 800 ft. A motor with instantaneous starting current of 15 amp. is assumed to be connected at a point 400 ft. from the transformer and the effect of changing from radial to parallel operation is shown for No. 2 and No. 4 secondary mains.

From the computations it is apparent that the flicker voltage drop at the service pole may be cut approximately in half by closing the sectionalizing circuit breakers and changing from a radial basis to a parallel operation with banked transformers. The diversity factor between loads is realized by the banking of the transformers, and as a practical matter it is possible to operate the distribution transformers on a winter peak load value right up to the maximum safe overload capacity when they are banked together. This is due to the fact that occasional overloads will be shared by adjoining units under conditions of parallel operation, whereas with radial operation some reserve has to be provided in each transformer for the occasional peak. From actual tests it has been found that 10-kva. transformers are sufficient in cases 2 and 3, whereas 15-kva. transformers would be needed in case 1, on a distribution system supplying a considerable amount of range and water heater load. Under such conditions a material economy is effected, as shown in the following comparison of the approximate installed cost of the variable units that are under consideration, expressed in dollars per thousand feet of three-wire secondary mains:

Case Number	Transformer Cost	Secondary Cost	Total Cost	Per Cent of Flicker Drop
1	$180.00	$162.50	$342.50	2.41
2	143.50	162.50	306.00	1.27
3	143.50	117.24	260.74	1.69

In considering the relative service reliability from a strictly radial system as compared with one employing parallel operation and banked transformers, the element of practical experience with different climatic conditions and types of design plays an important part. The frequency and severity of lightning has much to do with the burn-outs or blowing of fuses on distribution transformers. Experience has shown that cascading or progressive blowing of transformer fuses will often follow the burn-out of one unit or the blowing of its fuse during time of heavy load, where transformers of fairly large size are located close together on heavy copper secondary mains. This may cause a serious interruption and even necessitate sectionalizing of secondary mains before fuses can be replaced.

Prevention of cascading is a matter



Typical single-phase area on common neutral distribution system for lightly loaded residential areas

Uniform size No. 4 B. & S. main feeder, and a large number of line transformers banked together. On this type of distribution voltage regulation 2 per cent above and below normal can be maintained, practically all secondary short circuits and over 85 per cent of primary short circuits are automatically self-clearing.

Straight radial distribution with tapered primaries and banking of transformers on secondaries both have their merits and so does the fuller evolution of interconnection in the form of networks. The pros and cons are well set forth here in this paper, which is another in the series sponsored by the E.E.I. subcommittee on distribution costs, Merrill DeMerit, chairman. Previous installments have appeared in the April 27, June 22, August 3 and October 12 issues.

of engineering design. In important commercial areas with heavy load density the proper solution is the use of network protectors on the secondary side of large individual transformer units with heavy secondary mains, together with elimination of primary fuses and interlacing of primary feeders.

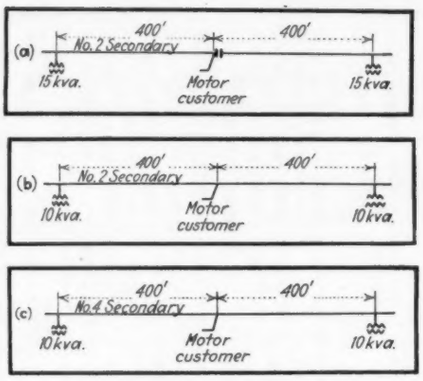
Where transformers are banked together in residential areas it is possible to eliminate extensive cascading by providing the correct minimum of impedance between transformers. This can be done by limiting the size of secondary mains where the mains are interconnecetd into a grid. Such a design will not only clear burned-out transformers successfully but will burn off wire short circuits in most instances.

Seattle has common neutral network

A specific example of the type of distribution referred to has been used by the Puget Sound Power & Light Company for many years in Seattle and in certain other smaller cities and was described in the ELECTRICAL WORLD of July 28, 1928, "Common Neutral Network."

The entire service area is covered by a grid network with a mesh of two or more blocks long and one block wide, varying with the local conditions. A uniform size No. 4 B.& S. weatherproof copper wire is used exclusively. A total of four wires are installed, one of which is located on the primary crossarm and is at a potential of 2,400 volts to ground, being one phase wire of the 4-kv. star primary system. The three other wires are on the secondary crossarm, one of which is the common neutral for both the primary system and the 120/240-volt, three-wire secondary mains, the two other wires forming the outers of the secondary mains. Line transformers of proper size for the load are installed as needed between the one-wire primary grid and the secondary mains. One primary transformer lead is connected to the middle, secondary lead for ground connection, and only one fuse cutout is installed on each transformer. Transformers are from 5 to 25 kw. in size. As many as 190 transformers are banked together on one networked phase area.

Porcelain circuit breakers are cut in the primary wire and the two outer secondary wires so as to divide the primary and secondary grids into phase areas, which may be anywhere from four blocks square to sixteen blocks square, depending on the load density. The size of the phase areas is such as to load up the standard No. 4/0 B.& S. copper primary feeder. These primary feeders are taken out from substations as three-phase No. 4 wire feeders, and on reaching the load area each phase branches off to supply one single-phase grid formed by sectionalizing the network as described above. The No. 4/0 primary feeder taps into the primary grid at a feeding point near the center. In the case of large phase areas there are sometimes two points of connection or feeding points. The only overload protection on this system is the substation circuit breaker, which consists of three separate single-pole units, automatically reclosing, and the primary fuse cutout on each transformer. Services into houses tap the secondary mains and there is no overload secondary protection except the customer's main line switch.



Relative flicker drops computed for three conditions

(a) Calculation of "flicker" voltage drop in transformer and secondary, using one 15-kva. transformer per 800 ft. of circuit, secondaries separate for each transformer. Motor with 15 amp. starting current assumed at 400 ft. from transformer. Secondary conductor, No. 2 weatherproof copper.

Starting current	15 amp.
Transformer drop	$0.289 + j\,0.325$
Secondary drop	$1.951 + j\,1.510$
Total drop	$2.240 + j\,1.835$
	$= 2.89$ volts, $= 2.41\%$

(b) Calculation of "flicker" voltage drop similar to case 1, but with secondaries in parallel between adjacent transformers. Transformer sizes can be reduced from 15 to approximately 10 kva. to supply the same load, made possible by the diversity on interconnected secondaries.

Refrigerator or oil burner current per transformer	7.5 amp.
Transformer drop	$0.196 + j\,0.218$
Secondary drop	$0.975 + j\,0.760$
Total drop	$1.171 + j\,0.978$
	$= 1.53$ volts $= 1.27\%$

NOTE—If 15-kva. transformers are used, neglecting the effect at diversity, the volts drop becomes one-half of paragraph 1, = 1.4 Volts = 1.17 per cent.

(c) Calculations of "flicker" voltage drop in transformer and secondary, using No. 4 W. P. wire for secondary. All other conditions same as Case 2.

Refrigerator or oil burner current per transformer	7.5 amp.
Transformer drop	$0.196 + j\,0.218$
Secondary drop	$1.560 + j\,0.785$
Total drop	$1.756 + j\,1.003$
	$= 2.02$ volts $= 1.69\%$

As load density increases on this type of distribution it is only necessary to install additional line transformer capacity between primary and secondary grids and to subdivide the phase areas by cutting in additional porcelain breakers. Additional primary feeders may then be strung out to feeding points in the newly formed phase areas of smaller size with heavier load density. There is practically no replacing of wires involved with increasing load. The occasional small three-phase motor is supplied by bringing in one primary wire from an adjoining phase area and hanging one transformer in open Y-delta with the secondary mains.

After a number of years' operating experience it has been conclusively shown that a very large percentage of all types of line trouble will clear themselves before the third reclosure of the substation breaker, except where the No. 4/0 primary feeder itself is involved. The limitation of wire size in the grid and the transformer spacing entirely prevent complete cascading of transformer fuses. A burned-out transformer is cleared by a primary fuse and usually burns open on the back feed from the secondary mains. Occasionally a short-circuited transformer will not burn clear from the mains, in which case the fuses on not more than one or two adjoining transformers may be blown and the voltage pulled down to a very low value in the immediate vicinity. This locates the trouble and service men are able to cut the transformer in the clear. The remaining transformers at distant points on the grid are not damaged, as the impedance of the long secondary feed prevents an excessive overload on any one transformer.

Whether the details of design follow the above described grid arrangement or whether the transformers are banked together between primary and secondary mains running in one direction only is a matter of some choice in adapting the system to the local conditions. The above experience, however, indicates the possibilities offered by a scheme of parallel operation with transformers banked together in providing economy, handling load growth, eliminating voltage flicker, insuring dependable service.

Let's Not Make the Same Mistake Twice

Raw Cheapness in the Approach to the Rural Market Does Not Pay—Start With Light and Service

By FRANK B. RAE, JR.

Expansion to the farm market should be in terms of service rendered. Care should be taken to avoid the growth of a host of minimum use customers. Sales of useful items should be advocated. Good advice, based upon past experience, on rural electrification.

SOME twenty years ago the utility industry was adding new customers at the rate of more than a million a year. The sales methods and inducements offered during that period of expansion were, as a whole, predicated upon cheapness and labor-saving. The soul-deadening drudgery of hand washing, the face-blistering discomfort of sad-ironing, the tuberculosis menace of broom-sweeping were expounded in tremolo tones—and then, "We will wire your home for 30 cents a room" (or some other silly sum) was the price proposition. The result of this approach was the adding of millions of minimum bill customers, who, to this day, represent a monthly loss to lighting companies.

We are now embarking upon another era of customer expansion—this time in rural territory. With government credit to outlying prospective users of electric service, and under government pressure upon utilities, the country's power network is being flung into the farthest hinterland. This is all to the good. If any one on Mother Earth deserves and profits by electric service it is the farmer. No need to expand this thought. We all know that life on the small farm is a very tough proposition indeed, and that it takes only a very few kilowatt-hours of electrical energy per month to transform a gnarled drudge into a country gentleman.

But there is a danger in this rural development — practically the same danger we met and failed to master in our past spectacular urban development. That danger is a selling approach based upon misconception. We are in danger of selling the wrong idea of electric service and selling it at a wrong price. Emphasis upon cheapness will defeat the real purpose of rural electrification; emphasis upon seldom-used appliances will defeat it. We stand in danger of having on our lines additional millions of customers wearing out their spectacles examining our monthly bills and rueing the day they invested anywhere from three to five years' energy charges in idle appliances.

Acme of asininity shown

This writer recently saw an article in a farm magazine on the subject of rural electrification. The outstanding illustrations showed a woman using an electric sewing machine and a man using a motor-driven sharpener. The theme of the article was, "Let electricity do the work." What an asinine approach to rural electrification! The sewing machine is used no more than 100 hours per year and the grinder not more than 50 hours annually on any normal farm. The jobs these appliances do for the farmer and his wife are insignificant, measured in terms of drudgery. The income they return to the utility is equally insignificant.

Now, there are plenty of real jobs that electricity can do around the farm. Water pumping is primary. On a cold winter morning, taking a steaming teakettle out to thaw and prime the hand pump, then lugging water back to the house for the day's sloshing and out to the horse trough to water the stock, is a real chore. Don't tell me—I know. And then, a good, sturdy utility motor—properly mounted and with proper accessory equipment—can do more work than three hired men and a team of mules. It will cut tough cornstalks and fill the silo and hoist hay into the mow and saw wood and run the orchard sprayer and otherwise make itself politely useful.

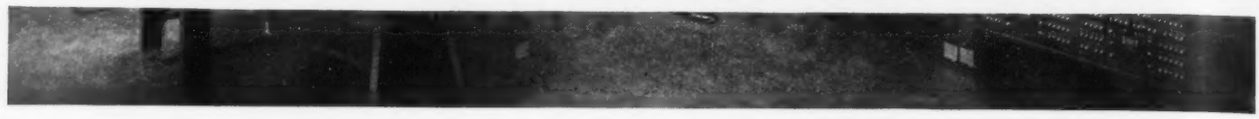
In the house there should be a washing machine, of course, an electric iron and a vacuum cleaner. These are real labor-savers which are also conducive to better health and the luxuriousness of cleanliness. They net the utility not more than 110 kw.-hr. per year altogether, but they build up indelible appreciation of electric service, which is the main point.

Yet pump, utility motor, washer, iron and cleaner are not going to make rural extensions self-liquidating. There is only one other commonly accepted form of electric service which *will* make the investment self-liquidating, and that service is—*light.*

One very keen observer who studied the subject of rural electrification for many weeks (at substantial expense) remarked that customers "take light for granted." That was the whole trouble with our customer expansion of two decades ago—we permitted customers to "take light for granted," with the inescapable result that they skimped their lighting facilities to the bone and skimped their energy consumption to the point where one out of three still represents a loss to the utility which supplies them. Let's not make that same mistake twice.

[*Continued on page 98*]

Board Earns 8 Times Its Cost



Management Tool for System Planning, Substantiation of Proposed New Investment, Based on Quick, Accurate Predictions of Performance, Saves Eight Times Its Cost

By T. G. LeCLAIR
Development Engineer Commonwealth Edison Company, Chicago

SAVINGS approximately eight times its installed cost appear from an analysis of the problems solved in the first two years of operation of the alternating-current calculating board of the Commonwealth Edison Company. The board, installed in 1932, is still the only one owned by an operating electric utility. It has been used in the solution of all types of network problems, including stability, load division and short-circuit studies, and involving all parts of the system from 132,000 volts down to 120 volts. It has proved to be of great value, especially in reducing capital expenditures, although it has been of aid in reducing operating costs and solving many technical operating problems. The variety of problems in which the board has been used is shown in the following list:

Part of System	No. of Studies	Part of System	No. of Studies
132 kv.	10	A.C. network	9
66 kv.	6	25 cycle	7
22 kv.	2	Miscellaneous	3
12 kv.	27		
			64

The greatest number of problems solved related to the intermediate voltage transmission at 12,000 volts. In Chicago the substations are fed radially from the various generating and distributing stations at 12,000 volts. Groups consisting of from one to five substations are supplied by a network of underground cables. These groups are all of a size that lend themselves readily to an accurate solution on the calculating board.

Gets workout on Chicago fair problem

The Century of Progress Exposition, when it opened in 1933, required a temporary power supply fed by underground cable for a maximum load of 16,000 kw. The plant to be installed, including underground transmission lines and substations, was to be of no further value in this location after the close of the fair. The plan of energy supply to the fair was made and had been approved just before the calculating board was first ready for service.

As a test for the usefulness of the calculating board, this comparatively simple problem, involving three substations and a few industrial substations in addition to the group of transmission lines, was set up and studied. By testing a number of alternative arrangements of the lines, some of which did not appear feasible on inspection, a new scheme was designed which eliminated one complete underground cable from Fisk Street generating station, effecting a substantial saving in conduit work. This new connection scheme was used to supply the Century of Progress. It was installed with the confidence that the transmission capacity would be ample, under all reasonable conditions, for the load estimated by the fair management.

This one comparatively simple problem effected a reduction in capital expenditures which more than offset the cost of the calculating board.

Another problem, of a somewhat different nature, for which the calculating board was an invaluable aid was the study of the transmission capacity available to supply the load connected to Calumet generating station, when it was proposed to shut down this station for coal economy because of the decrease in load during the depression.

This generating station is connected to the 66,000-volt system through two 60,000-kva. transformer banks and, in addition, is connected to two other generating stations through several long 22,000-volt underground cables. The interconnected network was so complicated that it could not be solved analytically, and an inspection of the diagram indicated that the 22,000-volt cables would be of no appreciable value in supplying Calumet load if one of the 60,000-kva. transformer banks was out of service.

A study of this problem on the calculating board showed that with proper system connections, and by the use of certain taps on the 22,000-volt transformers, it was possible for the 22,000-volt lines to carry their full capacity into Calumet during an emergency

condition, when one 60,000-kva. transformer bank was out of service. As a result, it was found that an additional 60,000-kva. transformer bank would not be needed to carry the station load with the generators out of service.

Stability problems do not always yield answers that can be directly translated into dollar savings, although the results are of definite tangible value. For example, the stability studies on the Powerton-Chicago overhead transmission lines at 132,000 volts were instrumental in increasing the loading limits of these lines and giving the operators confidence that the limits specified were accurate.

Jointly designed by user and builder

Static stability limits of a power system are very easily determined on the alternating-current board, since it is only necessary to set up the equivalent network, and then advance the phase angle of the sending station until the maximum power output is reached. In the solution of transient stability problems the step-by-step method used in long-hand solutions must also be resorted to in the board solution, but the volume of work is greatly reduced, since the system conditions corresponding to each step are obtained from board readings instead of from the solution of simultaneous equations. When such problems are complicated by the effects of single-phase and phase-to-ground short circuits the a.c. board furnishes a tremendous advantage, because it greatly simplifies the use of symmetrical components in the solution. The three networks for the positive, negative and zero sequence components may be set up on the board and the solution obtained directly.

Use of the board in this field is of appreciably more value to a power system consisting of widespread networks with overhead lines than it is to a metropolitan underground system, where stability problems are of comparatively little consequence.

To a metropolitan system the most valuable use of the calculating board is in the solution of load division and voltage regulation problems involving networks of transmission lines with scattered loads and possibly scattered power sources. In such problems it is usually necessary to analyze a number of various conditions in order to determine if the line capacity is sufficient, or to study other matters of interest. In the long-hand solution the analysis of each condition necessitates the solution of a number of equations and, therefore, the labor of obtaining a complete solution, and the dangers of inaccuracy are so great that ordinarily it is not advisable to attempt a thorough analysis.

Stability, load division and fault conditions are readily studied by means of this calculating board. Embracing five power sources, 48 load circuits, 72 line circuits, eighteen tap changers, 24 condensers and a few miscellaneous circuits, it constitutes a replica of almost any feasible power system and shows where new equipment is needed or new operating procedure is desirable to improve economy and reliability.

As a result, the installation of additional capacity is usually based upon inspection or a few meager calculations. With the calculating board, however, the system, when once set up, can be altered very quickly, and a number of conditions may be studied with relatively little work. In this manner the most economical size and method of connecting a new transmission line can be obtained promptly and with an assurance of accuracy.

Not the least of the advantages of the calculating board over any other method of solution is its ability to simulate the effect of tap-changing transformers and of condensers.

Short-circuit currents are ordinarily determined more quickly with a direct-current calculating board. However, the alternating-current board makes possible the determination of short-circuit currents at the same time that the load study is being made. The solution on the a.c. board is also much more satisfactory when the lines involved have an appreciable ratio of resistance to reactance, or if the line impedance is great enough so that the effect of the load must be considered. This is particularly true if the load power factor and the power factor of the short-circuit current as determined by the impedance angle of the line are quite different. Another advantage is that the effect of mutual impedance between adjacent transmission lines may be included in the solution by fairly simple means.

Board has limitations, too

In general, it has been found impracticable to determine losses directly from the output and input on the miniature set-up. For stability studies on very large systems it will be found impractical to set up the entire system if the number of power sources in a widespread transmission system exceeds five or goes above ten in the compact metropolitan type. The character of the system will determine the exact number of sources which can be used efficiently on one study. Beyond this limit the time involved in adjusting voltage and current relations is so great that it is better to break down the system into parts, solving each part separately, with the remainder of the system represented by an equivalent power source of impedance.

For simple circuits, such as the short-circuit current through a single transformer, or a single transmission line, a long-hand solution is much quicker than the use of the calculating board. However, the Commonwealth Edison board has performed valuable services during the last three years, in spite of the lack of extensive system expansion. With increases in load, which will necessitate more frequent changes in system capacity, the a.c. board will be even more valuable.

Time Requirements for A. C. Board Studies

High Voltage	Days
132-kv. power flow or steady-state stability	
(a) Two-machine case (Powerton-Chicago)	
Preliminary work and board set-up..	1
Each set of readings (including recording)	½
(b) Four-machine case (A.G. & E. interconnections)	
Preliminary work and board set-up..	1
Generator adjustment	1
Each set of readings	½
(c) 66-kv. system in Chicago (5 machines)	
Preliminary work and board set-up..	2
Generator adjustment	1
Each set of readings	½
12-Kv. Group Study	
For typical group consisting of 5 stations and 15 line circuits	
Preliminary work and board set-up..	1
Analysis of each set of conditions..	½
Short-circuit currents at all substations for each set of conditions...	½

Note: All measures of time are on the basis that two men are working together. Time necessary to obtain load data and calculate system constants not included in tabulation. Additional conditions for any problem can usually be solved much faster than the first condition, because it is often possible to eliminate many readings that are not required for the problem at hand.

Modernizing a Malt House

Extent to Which Old Equipment Was Used or Replaced With Modern—Minimizing Peak Loads—Switching, Drives and Control

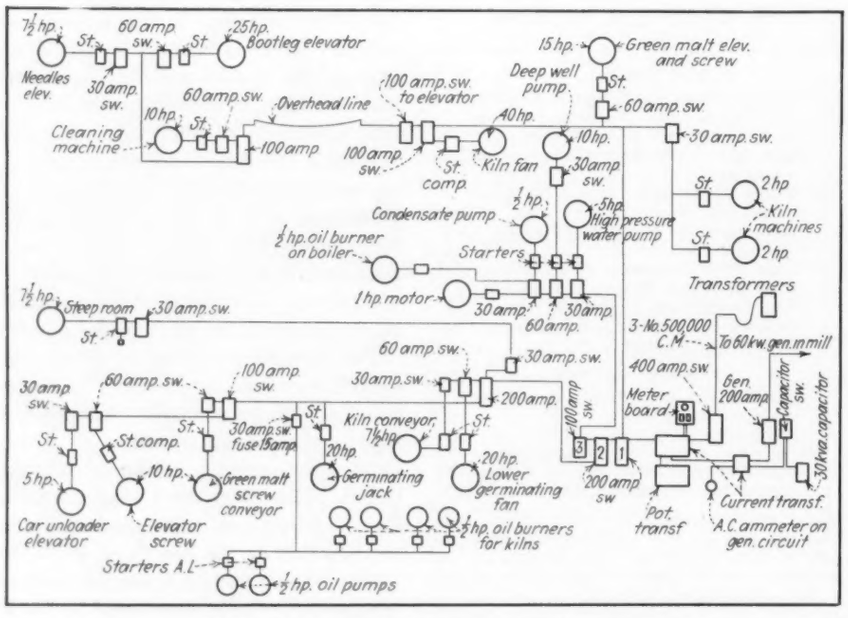
By K. B. HUMPHREY
Sayreville, N. J.

ABOUT $7,000 was spent by the Interstate Malt Company for electrical rehabilitation of its malt house at Waterloo, Wis., which had been shut down in 1918 and is now again in operation. The plant had been run by thirteen direct-current, 2,200-volt motors, totaling 163½ hp., the energy supplied from three generators in parallel, a 25-kw. and a 75-kw. unit, each driven by a steam engine, and a 40-kw. waterwheel unit. To restore this system would require new boilers for the steam engines and even then the generating capacity would still be short, because the hydro power could not be depended on. So it was decided to replace the d.c. equipment with a.c. and to purchase electricity, using the water power when, as and if it is available for use.

The old d.c. motors were pretty antiquated; some of them had been second-hand when installed. They had no trade-in, only junk, value. The most that could be salvaged for use in the new installation was a few pull boxes and about 80 ft. of 2-in. and 200 ft. of ¾-in. conduit in place. Some 1-in. and 1¼-in. conduit was taken down and used in various places in the new system. Some of the wire was in good shape and could be used again. The old lighting system was 220-volt d.c., taken directly off the motor feeders for each section or room. It was all open wiring and some of it was used in the new installation. The accompanying table shows the motor drives and the motors substituted. In most cases the original drives were retained and new motors substituted at nearly the same speeds.

The job of electrical modernization arranged itself naturally into a schedule:

1. Connect up old wiring for lights and power for hand tools used in construction.
2. Pull in feeders and in general put the whole lighting system into final shape.
3. Take out all of the old d.c. motors.
4. Remove old wires and conduit.
5. Remove generators.
6. Put in new conduit where necessary and install feeder switches for the individual motors, also service entrance.
7. Run main feeder wires.
8. Place a.c. motors and wire up from mains to motors.
9. Install capacitor.
10. Run wires overhead from mill to malt house.
11. Install 440-volt alternator in mill.
12. Place in position emergency d.c. motors on the two fans.



Modernized electrical layout in malt house

All switches are Westinghouse type WK-97-C safety switches. Circuit No. 1 has a total connected load of 101½ hp.; circuit No. 2 83 hp. and circuit No. 3 17 hp., a total of 201½ connected horsepower.

The lighting system was connected to three-wire, 220-110 volts, supplied from a 7.5-kw., single-phase transformer of the indoor oil-less type, connected on one phase of the power supply near the service entrance. The work required to put the lighting system in shape was considerable. Wherever possible the old wires were used. Most of these were open and needed to be straightened up. Wherever the wires came down for switches, conduit was put in. Conduit was also used on all the stairs or wherever the wires came within reach. A main distribution panel was installed and from this were fed three distribution panels in the "steep" room, the growing compartment and the elevator building. The rest of the circuits come out of the main board. There are about 125 outlets for lights and three $\frac{1}{6}$-hp. motors connected to fans on Moore heaters. Approximately half of the system is in ½-in. conduit, one-fourth

List of Motors and Replacements

Motor Location Driving	Old D.C. Motors Speed	Hp.	Replaced by New A.C. Speed	Hp.	Control	Drive
Germinating fan kiln screw con.	650	30	860 1,150	20 7½	A.L. A.L.	Belt Belt
Germinating jack	625	20	860	20	A.L.	Belt
Green malt screw	800	10	1,150	10	H.C.	Belt
Elevator screw	825	7½	860	10	H.C.	Chain
Car unloader	800	5	860	5	A.L.	Gear
Upper kiln fan	650	30	860	40	H.C.	Belt
Green malt elev. and conveyor	650	15	860	15	H.C.	Belt
2 Kiln machines	1,000	2	1,750	2	A.L.	*Gear
Cleaning machine	1,200	10	1,150	10	H.C.	Belt
Bootleg elevator	590	25	575	25	M.C.	Chain
Needles elevator	New	..	1,750	7½	A.L.	†Geared

Motor Location Driving	Old D.C. Motors Speed	Hp.	Replaced by New A.C. Speed	Hp.	Control	Drive
Steep room conv.	1,000	5	1,150	7½	A.L.	Belt
Deep well pump	Steam pump	..	1,750	10	A.L.	Direct
Booster pump	Steam pump	..	3,600	5	A.L.	Direct
Condensate pump boiler feed	Steam pump	..	1,750	½	A.L.	Direct
Shop	1,000	2	1,150	1	A.L.	Belt
Oil burners (5)	Coal fired	..		5½ hp. 2½	A.L.	Direct
Oil pumps	New	..		2½ hp. 1	A.L.	Gear
Total horsepower	163½		201½			

*Geared direct to 87 r.p.m. †Geared down to 44 r.p.m. A.L. across the line starters. H.C. hand-operated compensator. M.C. magnetically operated compensator.

in BX and the rest open wiring. The whole system now complies with the code, whereas very little of the old system did.

Auxiliary generator carries peak

Wherever possible new a.c. motors of the same speed and rating as the old d.c. units were fitted to existing drives. This was not always practicable and some pieces of equipment whose speed could safely be increased are now running a little faster than they did before. On others it was necessary to make some adjustments of pulley diameters. The total connected load is now 201½ hp.

The peak load in malt house operation comes early in the morning, when the germinating compartments are being cleared, and lasts from two to four hours. The compartment and kiln fans run continuously throughout the 24 hours; the other compartment and kiln machines are run an hour at a time several times during the 24 hours. To cut down the demand charge a 60-kw. generator was connected to one of the available waterwheels. As it is usually possible to get enough water from the mill pond to operate from two to three hours during the peak load a considerable saving is made in the demand charges. By using an overexcited field some power-factor correction is obtained.

During periods of high water the generator is operated continuously. The wheel is started up and regulated by hand until the proper speed is obtained and the generator synchronized and thrown on the line, operating in parallel with the supply system. No governor at all is used and the wheel is driven wide open at all times; that is, the generator is set to furnish a certain amount of power and the variations are taken by the purchased power. If the village power should fail the generator could be used to keep the essential machinery in operation until service could be restored.

There are two waterwheels in the old mill and the second one is connected by belt to an old d.c. generator which can be used to operate either of the two fans. A direct-current motor is mounted on each case in such a position that with only a few minutes work the belt may be shifted from one to the other. During periods of very high water both wheels can be operated, one fan being run continuously with d.c. This gives an emergency source of power. While the alternator is in operation some power-factor correction is obtained. To supplement this a 30-kva. capacitor is installed in the old engine room and connected as shown in the wiring diagram.

With the capacitor cut in the power factor will run about 88 per cent, while without it the power factor runs below 70 per cent.

TUBULAR LAMPS FOR NARROW BAYS

A. L. Powell

Line-of-light lamps have been used to light the "Chatterbox" night club, Pittsburgh. This type lamp is adapted to use in narrow confined regions where evenly distributed light from a conspicuous fixture is desirable. These lamps operate on standard outlet voltages, can be used for direct lighting or for indirect effects when placed behind moldings with reflectors.

Telescope Control Refined

Highly Smooth Motion and Speed Control Provided With Pedestal Control of Motors on Telescope Tube

Proverbial handwheels, long shafts and bevel gears are lacking in modern telescopes. In their place come full electrification and remote control for the astronomical precision demanded. Control cables are inside declination and polar tubes; relays in a cabinet on the rotating member. The principles involved are adaptable to other work requiring nicety and precision in research laboratory drives.

By SIDNEY WATKINS
Electrical Engineer Warner & Swasey Company, Cleveland, Ohio.

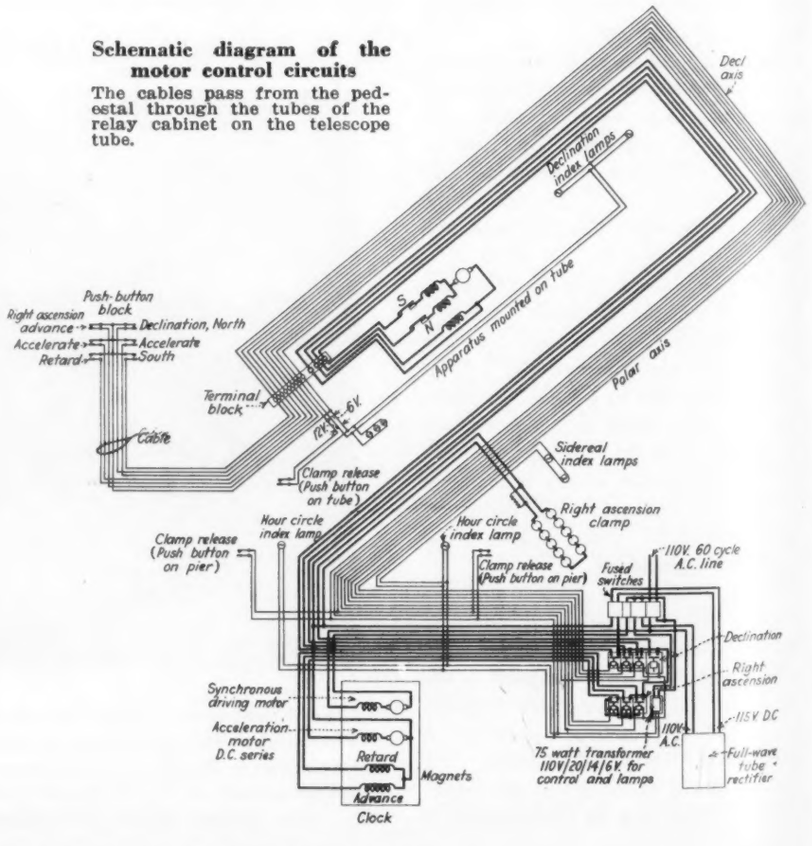
APPLICATION of electrical equipment to control the movements of telescopes of medium and large dimensions has been an important factor in obtaining the smoothness of operation and flexibility of control demanded in modern instruments. Not only must the telescope be constructed in such manner as to hold the optical parts invariable and without flexure in their correct relation to each other, but the whole optical combination must be moved smoothly and be able to function equally well in any position. The use of ball bearing and gear reduction motors has almost eliminated hand operation of telescopes of even small dimensions. Solenoids and magnets for operating clamps and shifting gears to obtain changes in speed have entirely supplanted older methods. Trolley wires and collector rings and flexible cables now carry the power to electrical equipment that governs movements that were formerly obtained by means of ropes and sheave wheels or long shafts and hand wheels.

A modern telescope of the simplest design and of only medium size requires from two to eight motors and numerous magnets and solenoids, with complete control made possible from several positions. In addition, at least three motors of larger capacity are required to operate the dome and shutter of the observatory itself.

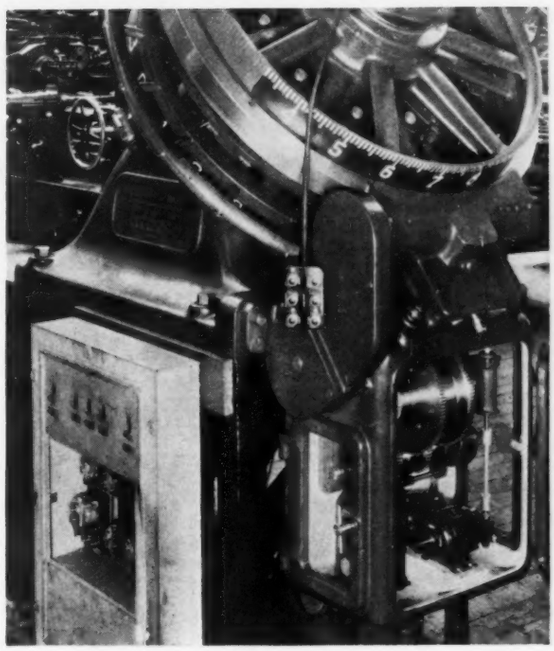
There are two primary movements required in the operation of a telescope: First, the quick-setting movement for pointing the instrument in the approximate direction for observing the desired object, and, second, the accurate sighting of the instrument to obtain the correct position of the object in the heavens and for following its movements. In the quick-setting movement the driving mechanism is geared rather high and the motor is comparatively large, giving a complete revolution of the instrument (if this is desired) in from five to eight minutes. The controllers are usually located on the floor level on each side of the supporting pier. On the other hand, for the accurate setting and following movements of the instrument the motors are almost unbelievably small, varying from 1/80 hp. to ¼ hp., depending upon the size of the telescope. With the rate of movement from one revolution in 24 hours to one revolution in 30 days the gear ratios can be low. The control of these movements is by push button and usually from two or more locations on the telescope tube in order to accommodate the different optical arrangements.

An ingenious use of relays to reduce the size of these push-button control cables and stations is found in a new 15-in. photographing telescope just completed at the plant of the

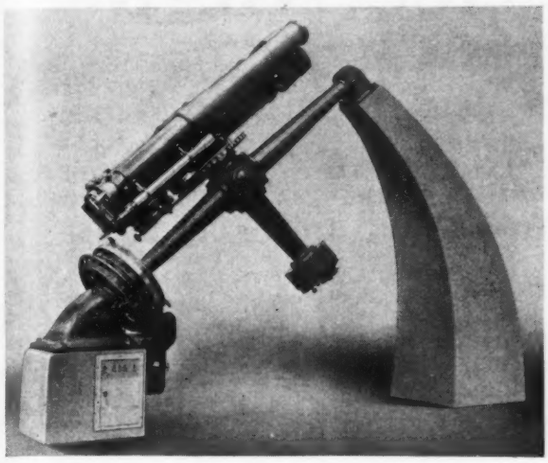
Schematic diagram of the motor control circuits
The cables pass from the pedestal through the tubes of the relay cabinet on the telescope tube.



Seven low-voltage relays, in cabinet at left of instrument base, permit a concentration of six controls in a hand-size push-button station



New 15-in. photographic telescope for U. S. Naval Observatory at Washington, D. C.
uses low-voltage control circuits for its driving motors, gear-changing solenoids and magnets.



Warner & Swasey Company, Cleveland, Ohio, for the U. S. Naval Observatory in Washington, D. C.

Long exposures demand concentration of controls

A small-size control was desirable because it is necessary in a photographic telescope for the observer to maintain a very accurate control of the instrument over exposure periods which frequently last as long as six hours. To undertake to control the setting and following movements of the instrument from several scattered locations over as extended a length of time would become very fatiguing indeed.

The six-button control station for this instrument is constructed of bakelite, is 4 in. long, 2¾ in. wide, 1 in. thick and uses a standard elevator annunciator cable containing eight wires plus two held in reserve. Concentration of so many controls and control circuits in so small a push-button station necessitated the use of relays for the operation of the 110-volt motors and solenoids through lower voltage circuits.

The control cable extends from the portable push-button station to a terminal box on the side of the telescope tube. From this terminal box to the cabinet containing the relays and control switches flexible cable is also necessary to accommodate the movements of the separate parts of the instrument. This cable is run in standard steel tubes on the outside of the telescope to the supporting axis, which is known as the declination axis. It then passes through the center of this axis and comes out of the side near the point where it crosses the main supporting axis of the instrument. This latter is known as the polar axis and is constructed at right angles to the declination axis and supported by two piers of unequal height so that it is parallel to the earth's axis at the point of installation at the surface of the ground.

To facilitate the movements of the two axes cables are given several loose turns around the declination axis before passing down through the polar axis to the relay cabinet on the side of the base. Two cables are required between the relay cabinet and a terminal box on the instrument. One is the low-voltage control, the other the standard voltage to the motors, control solenoids and magnets. The only exposed wiring is that at the motor terminals, the solenoids, the magnets and lighting sockets and the flexible cable to the portable switch-button station.

Direct current for operating the solenoids and magnets is obtained from the alternating-current supply through a 110-volt tube rectifier of 5 amp. capacity.

Power Commissioner Disclaims Pre-emption of State Regulation

THE new Utility Act . . . proceeds upon the sound assumption that the power industry is primarily a local industry and that the primary regulation of this industry should rest in the state. While the control of the interstate wholesale rate, which is constitutionally beyond the power of the state, is conferred upon the Federal Commission, the Federal Commission is ordered by the act to keep its hands off the local rate, and that prohibition upon the Federal Commission applies even to those cases where the energy locally distributed is the subject of interstate commerce. The only rate control, therefore, which can be exercised by the Federal Power Commission under the new act is that over the interstate wholesale contract, which is beyond the pale of state constitutional authority.—*Federal Power Commissioner Claude L. Draper, addressing National Association of Railroad and Utilities Commissioners, Nashville, Tenn.*

Selling Cleaners—From the Service Angle

Several Million Worn-out Cleaners Menace the Good Name of Electric Service—And Even Sixteen Power Companies Which Sold the Most Last Year Are Doing Little About It

FEW power company sales managers show any interest in vacuum cleaners. This appliance simply does not figure in the average utility sales program. Because they consume so little current and are so well established in popular favor most companies have decided that here is something they need not bother about. Yet on some systems cleaners are still being pushed aggressively and successfully.

There are good reasons. In the first place, any appliance connected to the lines that is in constant use in 10,500,000 households in the country is important to the power industry. Any piece of equipment that one-half of the domestic consumers of any company are working with day after day is a major feature of that company's service from the housewife's point of view. And if that appliance has a normal life, or rather a normal good health, of only 7½ years, because of the hard usage it receives, it becomes a serious responsibility in the maintenance of good service and good will.

For the purpose of reflecting this condition in the domestic service of the average power company the accompanying data on the cleaner sales of sixteen utilities have been tabulated. The companies represented have been selected from the study of the merchandising activities of some 100-odd power systems published in ELECTRICAL WORLD on March 2. They were the listed companies, outstanding in cleaner sales during 1934. They are presented here for the purpose of comparing the size of the communities, the extent of each company's total appliance sales, the number of its salesmen and its promotion program—if any—all in relation to the number of cleaners sold. The point of interest, however, lies not in the number sold, but in the contrast between utility sales plus local dealer sales—as estimated—and the need for cleaner sales to take care of new families and replacements.

For this matter of the replacement of worn-out cleaners to insure good service in the home has taken on impressive proportions. With some 10,500,000 cleaners in use, the normal expectation for replacement would be perhaps 1,300,000 machines a year, if a thorough job of reselling was done. But that's not the whole story. Eight years ago—in 1927—the total sales of vacuum cleaners in this country was 1,194,614. In 1928 it was 1,219,460. In 1929 it was 1,253,202 and in 1930 it dropped to 960,343. In 1931 the total was 686,648. Then it went down to a low of 447,056 in 1932 and rose in 1933 to 547,536 and last year to 722,367, according to the figures of the Vacuum Cleaner Manufacturers Association. So there were more than a million eight-year-old cleaners due for replacement in 1935.

According to the best estimates, the total sales of vacuum cleaners this year will be about 1,030,000. We have left piled up behind us, therefore, an unsold market for many million cleaners—it's anybody's guess, how many—and can look forward to an additional million more cleaners due for replacement annually for the next three years at least.

The natural reaction of the power company man to this is to say: "Well, let the manufacturer get busy and clean up this situation. Let the dealer sell them." But the answer is that the manufacturer cannot be expected to accelerate his sales in any large measure. It will be a gradual increase with him, and with the dealer also. The replacement of these millions of worn-out cleaners, that are either giving poor service and making the customer sore or have been thrown aside and are no longer turning meters, is something that the power company must look in the face. If the situation is to be cleaned up rapidly, it calls for a real clean-up campaign, led by the utility in active promotion and selling, with all the manufacturers and dealers in the local market co-operating actively.

So the cleaner question for the individual power company gets down to these considerations:

1. How many of its domestic consumers depend upon electric service for cleaning floors? And the answer is about 50 per cent.

2. How many of these cleaners are in bad order and a threat to customer good will? Probably all of them over eight years old.

3. How long is it going to take the manufacturers and dealers to step up their sales enough to replace this obsolescence? There is no assurance that they will do anything immediate about it beyond the natural building of a gradually increasing volume.

4. What could be accomplished by a concentrated industry drive, well organized under power company leadership? The answer is obvious and a little study of Tables I and II certainly drives the point home.

Here are sixteen utilities that stood out among 100 during the past two years for cleaner sales. They are located in communities ranging in size from 764,613 to 77,705 domestic consumers. But size hadn't much to do with it apparently, except for Companies A and B, which stand first and second in size and second and first in cleaner sales. For Company I stands

Vacuum Cleaner Sales by Sixteen Power Companies

A comparison of methods and results to indicate a neglected service responsibility—Experience of a group of companies that led in sales last year.

TABLE I

Company	Total Domestic Consumers Dec. 31, 1934	Av. Total Dom. Consumption June 30, 1935	Av. Revenue from Dom. Cons. 1934	Av. Rate per Kw.-Hr. to Dom. Customer-Cents	Av. Sales of Appl. per Cons. 1934	Present Sat. of Vacuum Cleaners %	Total Cleaners Sold by Company						Total Cleaners Sold by Dealers—Est.			% of Dealer Sales in 1934-1933	No. Salesmen Selling Cleaners Average 1934
							6 Mos. 1935	1934	1933	1932	1931	1930	6 Mos. 1935	1934	1933		
A	764,613	766	$33.69	4.4	$4.46	65	1,994	4,463	3,101	2,747	5,789	10,443	.....	.....	.....	.....	40
B	713,621	511	34.42	5.5	3.47	68	2,737	4,887	4,825	5,171	6,226	8,048	.....	25,000	23,000	83	145
C	533,123	675	34.30	5.5	3.75	78	588	1,907	1,498	1,343	3,042	6,353	.....	27,240	21,400	93	181
D	476,896	719	28.99	4.0	1.48	.....	387	860	453	621	1,092	1,240	.....	.....	.....	.....	.....
E	316,008	626	35.48	5.6	3.09	.....	464	1,251	1,136	1,565	4,351	4,542	.....	.....	.....	.....	*28
F	300,690	609	33.96	5.5	2.98	95	763	1,344	1,557	1,276	2,513	3,400	3,800	4,705	4,500	76	.....
G	295,793	530	35.75	6.7	5.09	.....	433	837	453	679	1,361	2,010	4,186	.....	.....	.....	201
H	279,611	754	34.54	4.5	3.09	56	911	1,990	1,593	.....	.....	.....	9,110	20,000	16,000	91	20
I	278,357	665	27.97	4.0	6.10	.....	1,731	2,813	1,590	1,614	2,229	3,396	.....	.....	.....	.....	25
J	232,403	643	37.99	5.0	3.37	83	1,297	1,485	1,329	619	989	1,575	.....	.....	.....	.....	61
K	197,706	707	30.05	4.0	2.56	.....	651	1,410	1,453	2,067	3,759	3,712	.....	.....	.....	.....	6
L	156,633	482	34.73	5.0	3.80	45	334	802	689	592	1,261	1,936	400	883	848	54	57
M	155,781	664	31.21	4.0	8.00	40	644	1,158	626	463	794	1,357	700	1,200	750	52	40
N	147,371	704	33.60	3.0	7.95	.....	534	988	825	718	1,255	1,375	.....	7,000	5,000	87	115
O	100,793	502	29.99	5.5	6.40	85	618	1,067	901	1,581	1,910	1,484	.....	.....	.....	.....	35
P	77,705	615	45.66	7.4	7.50	70	472	838	1,010	1,429	896	698	1,500	4,000	5,000	83	18
Total	5,027,104	[A]636	[A]$33.90	.....	[B]$5.33	.....	14,558	28,100	23,039	22,485	37,467	51,569	19,696	90,028	76,498	.....	.....

[A]Straight line average. [B]Weighted average. *Does not include store salesmen.

TABLE II

	Does Co. Finance Time Sales	Maximum Time Given	Compensation Paid to Cleaner Salesmen	Extent of Promotion Program	Dealer Co-operation Provided
A	Yes	19 months	Straight com. 15% under $40 sales, 18% above	Year round selling supported by newspaper and mail and radio	Finance, little contact
B	Yes	18 months	Commission 15% with guarantee of $65.20 a month	Extensive continuous adv., window displays, free trials 1 week, employee leads. Special price floor and hand combination	Educational adv. Co-operates through local leagues
C	Yes	18 months	Salary and com. equal to 11% of net sales, plus variable load bonus	No intensive promotion	Co-operates through local association
D	Yes	12 months	Sold by salaried commercial organization	No promotion program	None
E	Yes	12 months	Commission 10% with $15 per week minimum	Little promotion. Spent, 1934, $2,543, shared by manufacturer	Finance, free adv. material, demonstrations, meetings, sales help
F	Yes	.....	Manufacturers resale operation	No promotion campaign	None
G	Yes	12 months	Salary $55 per month plus $1.80 bonus per cleaner	No special promotion	Adv. features dealers, sales training
H	Yes	12 months	Manufacturers resale operation	Manufacturer's resale operation	None
I	Yes	18 months	Manufacturers resale operation	Extensive adv. and canvass, continuous floor demonstrations	None, except indirect financing
J	Yes	12 months	Salary and commission plus bonus for high sales	Limited—some newspaper adv.	Limited—keeps dealers informed
K	Yes	18 months	Straight com. 10 to 20% depending on source of lead and price	Newspaper adv., direct merchandising	Co-operates in shows and lectures, newspaper advertising
L	Yes	12 months	Straight com. 5% or salary $15 to $25 a week plus com. 6 to 8%	No special promotion	Adv. features dealers who may act as company salesmen
M	Yes	12-18 months	Manufacturers resale operation, pay com. 18⅔ to 20%	Constant canvass	None
N	Yes	12 months	Com. 16% for cash or 25% on minimum down payment, 14% on other time payment sales, guarantee $50 a month	Mail adv. Spent $1,000 in 1934	None
O	Yes	15 months	Salary $45 a month plus 10% com.	60-day campaigns—spring and fall—newspaper and radio adv. Bonus for employee leads	Co-operates through local association, displays, demonstrations
P	Yes	18 months	Straight com. 20%	Newspaper adv., billboards, stuffers, displays. Spent $3 per cleaner	None

third, Company H stands fourth and Company J stands fifth.

And, of course, it isn't the number of salesmen either, for these men, in most cases, sell the full line of domestic appliances, or at least a good part of it, and give only part time to cleaners. So, Company G with the most salesmen stands No. 14 in sales. Company C, second in number of salesmen, stands No. 6 in sales. Companies B and A, which are first and second in sales, stand No. 3 and No. 7 in size of selling staff.

Just as we have seen in previous articles of this series, studying results obtained by leading load builders with ranges, water heaters, refrigerators and laundry equipment, neither the size of the city nor the number of salesmen governs the total sales in any comparison of power company selling today. It is the intensity of the selling that piles up the total. With an appliance of high saturation, like vacuum cleaners, total sales, of course, should closely follow the number of domestic consumers in such a tabulation, if they were being sold.

These sixteen companies are all comparable in their average annual appliance sales per customer, all low, none running over $8 and most of them under $4. In average annual domestic consumption they range from 766 down to 482 kw.-hr. Average revenue per domestic customer lies between $45.66 and $27.97. Rates run from 3 to 7 cents. Each of these cities is now well sold with cleaners. Saturations are estimated at from 95 to 40 per cent. But the cleaner market is nevertheless wide open in all of these territories, with conditions favorable to selling. If anybody doubts it let him check one of the eight companies listed here which were able to estimate the cleaner volume of their local dealers. Total up their sales of the last four years, reckon in the obsolescence by a rough guess and then compare it with the total number of connected homes.

The whole story comes in a glance over the methods which these companies have employed. Six companies out of the sixteen have not backed cleaners with any promotion, or none to speak of, and nine make no effort to stimulate dealer sales or by cooperation to encourage more active merchandising through the trade. In other words, there is no pressure behind this appliance, even among this group of power companies which stand out among the many for the number of cleaners that they marketed last year. And most companies have simply turned their backs on them.

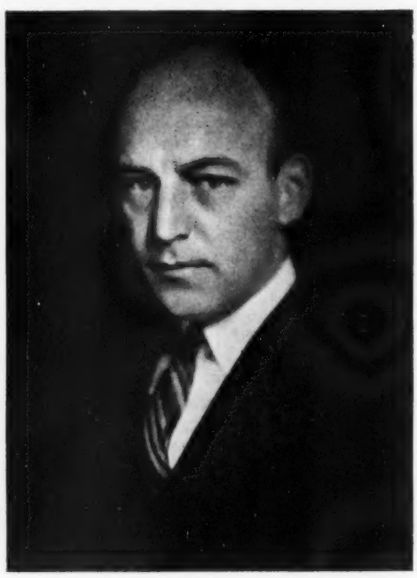
But the time has come now, it would seem, to recheck from the service angle this whole matter of the policy of the power industry toward the vacuum cleaner. Forget the low load value of the individual cleaner, though the revenue that comes from the great number now in use, each contributing its 36 kw.-hr. per year, is worth having. But what of the nuisance value? What is the cleaner worth to the household? How important is it to the utility that electric cleaning give general satisfaction to the customer? What is it worth to avoid the cost of all these service calls that broken down cleaners cause?

If any company decides that it is justified in making an effort to maintain electric floor cleaning in good repute among its customers, it can be done. For tie the cleaner into the sales program in proper balance and it will sell. Develop a stimulating co-operation with the local dealers and this volume will grow. And for those companies that hesitate to set up the necessary staff for the active canvassing that goes with cleaner merchandising, there is the manufacturers' resale proposition, now employed by four of these companies. The main thing, however, is to replace those superannuated machines that have worn out during the hard times and stand today a menace to the good name of electric service.

Guard Against Industrial Interruptions

DEPRESSION years have brought about some conditions within the customers' organizations and upon customers' premises that merit a great deal more than passing attention by utilities. Under the pressure of unprofitable operation, or the necessity for conserving cash, many high-tension customers' substations have been built or maintained under such competitive conditions that there are too many instances of second hand or inadequate equipment or deferred maintenance.

Recent improvements in business have caused conditions of overload on all kinds of electrical facilities owned by customers. Frequently these facilities were already in not too satisfactory a condition to meet even normal loads because of lack of maintenance during preceding years. Operating men in industry have in many instances been so long denied requests for proper electrical replacements or new construction that their morale is somewhat weakened and their performance not up to the standard of former years.



In some utility companies inspection service of industrial customers' equipment has been curtailed in the interests of economy, thus only aggravating these other, substandard conditions which industry has created. All these circumstances tend to produce an inferior service which reflects in many customers' minds upon the value and dependability of purchased power.

I urge that you make it a point to study your recent interruptions to industrial customers and compare them with the records of former years so that you may be able to determine their relative severity, regardless of whether their causes lay in defects in your own system or whether they rested with the customer.

GEORGE E. WHITWELL,

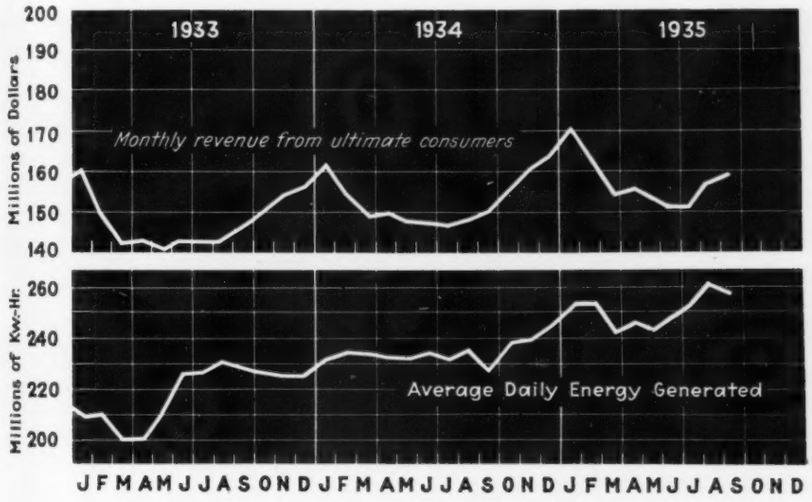
Vice-President Philadelphia Electric Company, in *UGI Circle*, October, 1935.

Utility Earnings Above 1929

Previous September records for revenue and energy sales were surpassed. Industrial energy rose 21.2 per cent above 1934.

OPERATIONS of electric light and power companies in September continued the rise noted in August. The revenue from ultimate consumers for the country as a whole was $159,072,800, according to the Edison Electric Institute, and therefore exceeded last year's $150,196,400 for the corresponding month by 5.9 per cent.

The highest previous September revenue was $158,870,800, in 1929; the amounts in 1930 and 1931 were nearly as large. Thus the previous record for a given month has been overtopped for the second time, but, as in August, the margin is small. That the upturn, which regularly occurs at this season of the year, is much more pronounced than it was in 1934 is evident from a comparison with the figures for July. A year ago the increase was $3,667,000; this year it was $7,858,000, or more than twice as great.


1933
1934
1935
Millions of Dollars
Monthly revenue from ultimate consumers
Millions of Kw-Hr.
Average Daily Energy Generated
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

The increase in energy production compared with 1934 was much larger than in revenue; it amounted to 13.3 per cent, total production being 7,742,000,000 kw.-hr. The decrease of 4 per cent from August is fully accounted for by the smaller number of working days, 24 in September against 27 in August. Water power supplied 36.3 per cent of the total and 23.5 per cent more than a year ago. Output from fuels rose 8.2 per cent.

Operating costs, taxes higher

Commenting on the steadily increasing energy production a recent statement by the E.E.I. points out that it does not follow that either the gross revenues or the net income of power companies are making similar gains. Most of the present increase in the use of electricity, it is stated, is confined to industrial power, which, with the exception of a few months during the war, is now selling at the lowest price in the history of American business. Of the balance, domestic electricity, which comprises less than one-sixth of the total sales, represents a service where enlarged use has been largely offset by lower rates. Meanwhile costs of materials and supplies are rising and taxes are continually becoming more burdensome.

Expanded industrial consumption, now up 21.2 per cent over 1934, accounts for most of the increase in energy sales. Regionally, revenue gains approaching or exceeding 10 per cent appear in the East North Central, Southeastern and Mountain areas, with much larger gains in output. Larger output from Muscle Shoals accounts for the apparent decrease in central-station output in the Southeast.

Table I—Monthly Revenue from Ultimate Consumers and Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1935	Revenue from Ultimate Consumers†		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
September	159,073	+5.9	7,742	+13.3	2,807	+23.5	4,935	+8.2
August	156,038	+5.1	8,071	+10.2	3,086	+32.0	4,985	+0.2
July	151,215	+3.2	7,845	+ 9.3	3,325	+37.1	4,520	—4.8
June	151,436	+2.8	7,416	+ 5.6	3,242	+26.9	4,174	—7.2

Table II—Regional Revenue and Energy Output in September, 1935

Compared with Corresponding Month of Previous Year

Geographical Region	Revenue from Ult. Consumers†		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
United States	159,073	+ 5.9	7,742	+13.3	2,807	+23.5	4,935	+ 8.2
New England	13,204	+ 6.9	526	+17.6	171	+ 6.2	355	+24.0
Middle Atlantic	44,648	+ 2.2	1,859	+ 8.0	441	— 2.2	1,418	+11.4
East No. Central	36,246	+ 9.7	1,824	+13.2	153	+ 9.4	1,671	+13.4
West No. Central	13,348	+ 3.4	507	+15.4	124	+99.5	383	+ 1.4
South Atlantic }	20,570	+10.1	929	+26.7	485	+18.0	444	+37.8
East So. Central }			289	— 0.3	232	— 0.8	57	+ 2.7
West So. Central	9,277	+ 1.5	414	+ 5.0	15	+112.0	399	+ 2.8
Mountain	5,039	+11.0	303	+41.6	239	+70.4	64	—12.3
Pacific	16,741	+ 5.7	1,091	+10.0	947	+42.4	144	—56.0

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central station.
†Preliminary.

Table III—Allocation of Energy September, 1935

Compared with Corresponding Month of Previous Year

Class of Service	Millions of Kw.-Hr.	Per Cent Inc.
Total for distribution*	7,795	+14.1
Lost in transmission, etc.	1,160	+ 9.7
Sold to ultimate consumers	6,635	+14.9
Domestic	1,135	+10.8
Com'l, small light and power	1,192	+ 7.3
Com'l, large light and power	3,676	+21.2
Municipal street lighting	189	+ 5.0
Railways—street, interurban	328	+ 1.6
Railroads—electrified steam	67	+23.3
Municipal and miscellaneous	48	— 0.8

*Generated, purchased from other sources, imported, less energy used in railway and other departments.

One of a Series of intimate Talks With industry Executives

Fisher on Sales Psychology

An Interview by
C. W. LEIHY

"LET'S start with fundamentals," was the way R. E. Fisher began to tell me about his philosophy of utility sales promotion. It was a characteristic statement, characteristic because this man, who heads up the sales activities of, and is responsible for, the public relations of the nation's third largest gas and electric utility, thinks along fundamentally straight lines.

"As I see it," he said, "the primary objective of our activities is to load the company's facilities for service as rapidly and as economically as possible. Every utility has three courses open to it as far as building load is concerned. It can build up a sales force to sell all types of appliances and compete with the established retailers, or it can leave the load building, as represented by appliances sold, all to the dealers, or it can work with the dealers with mutually beneficial results provided a plan acceptable to both parties can be devised. At the risk of getting a reputation for a 'fence-straddling' policy, P.G.& E. adopted the last of these and has gradually evolved an efficient and successful plan for co-ordinating load-building efforts with the retail merchandising outlets.

"We have been fortunate in having the confidence of the appliance retailers in our territory, who have been generous of time and effort in devising a plan to make the elements of the team pull together successfully. To do this, the company has divided its promotional efforts as equitably and fairly as possible between gas and electric appliance sales and gives the consumer facts from which he can make his own choice.

"Appliances fall generally into two broad classifications. In the first group are those appliances which already have public acceptance; that is, appliances which respond readily to good merchandising efforts. In this classification are refrigerators, table appliances, lamps and others which the public generally need, want and buy. In the second group fall those appliances which require strong promotional effort to move them in any volume, such as cooking, air and water heating appliances.

"In dollar volume the first group represents 90 per cent of the appliance sales volume. It accounts for 65 per cent of the new revenue gained by the utility. The second group, representing but 10 per cent of the total appliance sales volume, contributes 35 per cent of the new revenue added from appliance sales. Under our plan the utility not only turns over the entire first group of appliances, representing 90 per cent of the appliance business, to the retailers for exclusive exploitation, but also it contributes time, money and personnel to help the dealer obtain the greatest profit possible from the development of the appliance sales in this group. In the second group our company sells direct gas and electric cooking at prices and terms identical with those of the dealers. Thus, the company's direct selling is confined to that 10 per cent 'hard-to-sell' portion of the market.

"But the company does not by any means ignore the merchandising efforts of the retailers selling appliances in group No. 1. It has twelve dealer sales promotion men out among the dealers stimulating aggressive action in all phases of appliance merchandising. It has a very definite plan for contributing to the success of retail merchandising efforts. The success of the dealers in the territory is, in my opinion, due to a large extent to two co-operative promotional sales organizations, the Electric Appliance Society and the Gas Appliance Society.

"Behind the formation of these two societies is the premise that the retailers, whether gas or electric, are primarily interested in making sales and they realize that co-operative campaigns in which all retailers push the same appliances or groups of appliances at regular intervals have more effect upon the public generally than if each retailer carried on alone.

"To enlist all our possible sales outlets in an aggressive promotion program to sell current-consuming devices to the public requires harmonious teamwork. Therefore, the utility's program is really one of dealer sales promotion and not dealer co-operation. Pacific Gas & Electric Company contributes to the success of dealer sales efforts with advertising, personnel and prospect lists.

"Of paramount importance to the success of any dealer sales promotion program is the attitude of the utility employees. If retail sales outlets are going to help us sell appliances which will turn our meters, our entire organization must be thoroughly sold upon the value of working with the dealers' selling forces. By making the management fully aware of the revenue-building possibilities that are available through carefully planned and well-organized work with dealers and by convincing them that the *revenue brought in by dealer sales is just as valuable as increased revenue brought in through direct company sales*, management can be induced to invest the same amount of money per dollar of increased revenue produced through either channel. This is a big step in the matter of making dealer sales promotion pay, and the very fact that management has taken such a viewpoint is quickly reflected.

"The dealers in our territory will sell approximately $19,000,000 worth of appliances this year, which will bring the company almost a million and a half dollars' worth of additional annual revenue. The company's direct sales will be approximately $1,750,000, producing an annual revenue of approximately $750,000. From these figures you can see why we consider the retailers' selling forces a very valuable part of the company's sales department and why we have pioneered toward the goal of co-ordinated selling efforts for the past ten years."

R. E. FISHER, vice-president in charge of public relations and sales of the Pacific Gas & Electric Company, has pioneered in co-operative appliance merchandising. Here he presents some of the philosophy that is partly responsible for P. G. & E.'s consistent success in building new load.

ELECTRICAL WORLD

L. W. W. MORROW · EDITOR

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A New Era in Steam Stations

FACING a new era in power station building today recalls the conditions in 1921, when the small unit multiple boiler plants existed. Then the logic pointed to a gradual development of the single boiler-turbine unit of large capacity with a corresponding development in auxiliaries. Now the logic points toward a more complete realization of the unit station idea in a form that may be called a factory-built assembly. A compact power supply unit with boiler-turbine-condenser and auxiliaries designed as a single assembly in a minimum space without duplication of any equipment is the desirable goal. All items should be designed to fit together in each standard rated power assembly and in largest degree each complete unit should be a standard factory-built product independent of connections with any other unit or of its prospective location. The difference between stations would then be only in structures, circulating water supply, outgoing line arrangements and local variables. The power unit would be connected as a complete piece of apparatus to these local variables.

With the same speculative but logical analysis of conditions and possibilities it should be possible to devise similar standard and semi-portable power units to solve many industrial plant power and steam problems whereby they could have process steam, and yet the unit could be tied into the utility system as a decentralized utility-owned-and-operated generating station. Both these objectives offer economies and are in accord with the trend to generate power at the loads in simple and standard unit stations. When the full possibilities of this logical approach to the power generation problem are realized there should result a great reduction in fixed charges and a large increase in power use.

Power station practice in both its engineering and commercial aspects grew as the business and the art permitted in a period of rapid development. We have had a remarkable record of accomplishment and of economy under the conditions. But from now on there are equally remarkable records of accomplishment to be made in following the logical road to the desirable types of unit power stations that will be needed in the coming years. And undoubtedly commercial enterprises and power engineers will seize these opportunities in design, manufacture and commercial organization that lie waiting for action.

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Battery Advances in the Offing?

SOME of the electrochemists are quite outspoken when they meet in convention assembled. Witness the assertions that electrochemical batteries of all types have been yielding ground to electrodynamically generated power and that maybe the university laboratories will have to show manufacturers how to break long-standing traditions of battery composition for the sake of evolutionary or revolutionary advances in performance and application appeal. It was also asserted that storage and dry batteries alike were being produced essentially as they have been constituted for many years and that substantial departures were conceivably possible. At the very least the battery people, it was stated, should be seeking out new uses to compensate for the loss of applications to power systems.

Those are pretty vigorous remarks to quote about so big and active a component of the electrical industry as is that of making storage and flashlight batteries. Certainly if the lead battery, for example, were halved in weight, doubled in life and enhanced in efficiency (as was intimated to be in prospect) it would mean a fresh boost for the battery-operated truck. That, in turn, would be welcomed by the power industry, because such non-combustion vehicles would all represent a retrieved load for power systems. It is hoped that the electrochemists' comments are somewhat more than father to the thought and do really presage some early announcements in these directions.

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Watch Depreciation Regulations

UNIFORMITY in utility accounting for depreciation is a most desirable objective, but the urge is no excuse for fixing upon straight-line depreciation as the royal way to uniformity for all kinds of property. The puzzling difference between the accumulated depreciation reserves and the accrued depreciation in evaluated physical assets is no excuse, nor is the fact that bonds approach maturity along a straight line and property-worth travels a curve sharply ascending near the demise of the property, little of which differs much in practice from the "one-hoss shay."

A pretty good example of the fallacy of the straight-line leveling process can be found in the situation of a fully developed hydro plant owned by a corporation which has no other holdings. What can it do with the unnecessarily large contribution of the first

years toward the straight-line fund? It does not need those dollars; it wants them not because it cannot reinvest them in plant growth, of which there will be and can be none. Worse than that, it would work to the detriment of the company if this unduly large increment of depreciation reserve were deducted from the rate base to establish its regulated rate for wholesale power. In those same early years the earnings are likely to be subnormal because adjoining systems usually cannot wholly absorb the large block of power added in one lump when the plant went into operation.

The sinking fund more nearly meets the three requirements of accounting, amortization and earnings of this case. The retirement reserve method has superiorities over the straight-line method in the instance of property that grows steadily, property that depreciates more rapidly than hydro investments and property that is systematically maintained at frequent intervals to keep up to a competent service standard. Under the straight-line method the early ratepayers actually pay more than under the sinking fund, a discrimination in favor of posterity.

There is a wave of regulatory partiality toward the simplicity of straight-line depreciation. But, fortunately, the recent federal legislation has not shut the door on the other methods. The utility industry should not leave the solely hydro companies to be the only pleaders for logical latitude in depreciation accounting—and the only beneficiaries of a change of regulatory heart.

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Hockenbeamer Passes On

NEWS comes of the sudden and untimely death of A. F. Hockenbeamer, president of the Pacific Gas & Electric Company and father of customer ownership. His death is a sad blow to the industry, but his accomplishments and his career stand as shining monuments to inspire present and future generations. A. F. Hockenbeamer reached the heights of success through his own efforts. His record is an Alger story of "rugged individualism" so frequently decried these days.

He started as a poor boy without influence or advantages, but he worked and he studied and thus was able to mount step after step on the ladder of achievement. He went from janitor to messenger, to office boy, to stenographer, to railroad expert, to financial expert, to utility expert and finally to chief executive. His was the earned success built upon ability, knowledge and ambition that typifies America.

It is no wonder that Mr. Hockenbeamer brought a broad knowledge of business and finance, a rare ability for making sound decisions, a constructive and balanced imagination that always strove to advance and build and a deep understanding of human nature to bear upon the problems of his company and of the industry as a whole, whereby he obtained outstanding results. He learned how in the school of hard knocks and experience. Unselfish devotion to his company, to the interests of the communities it serves and to the co-operative activities of the utility industry were traits of Mr. Hockenbeamer that earned him the respect and commendation of all who knew him. As a citizen and as a leader of the industry Mr. Hockenbeamer stood in the front ranks.

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Added Capacity on Transmission Lines

INCREASED loads do not necessarily involve the addition of capacity to generating stations. Transmission properties should study carefully the economics of adding capacity by unloading wattless power from their lines by the use of synchronous condensers. This is inexpensive capacity that improves service and regulation. In many instances transmission systems could and should use synchronous condenser capacity up to around 50 per cent of their peak load.

Synchronous condensers are reliable units. One known example of a hydrogen-filled outdoor unit operated splendidly over a three-year period with no examination and little attention—a service record few steam turbines can equal. These synchronous condensers can be located where they will do the most good and require very little in the way of space, structures and accessories. We venture to say that many transmission systems can use them today to add capacity at an astonishingly low cost figure. Incidentally, on lower voltage and industrial applications capacitors come into play as a valuable engineering and economic tool. Low cost power is measured when delivered at the load; the generating station is only one element in the system capacity problem. Engineers will do well to look into this approach to added capacity.

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The Menace of the Broken Down Vacuum Cleaner

POWER company men think in terms of load. Customers think in terms of individual things that electric service does for them. It is only natural, therefore, when a utility pushes refrigerators, ranges and water heaters and does not sell vacuum cleaners and other small load appliances, that people should be suspicious. "All they want is to make my monthly bill bigger"—so goes the gossip. It may be unjust, but that's what people say in many cities.

It is not hard to understand, when a utility continually advertises the expensive services and keeps quiet about the rest. What would you think if you were just a customer? And when they tell you that these small load appliances are so well established in

public acceptance that it is not necessary to promote them, you answer, "So are shoes and soap." And when they say that they don't sell these things because they want the dealers to have the business, you just don't believe it. The world is not set up that way.

For this reason the article on vacuum cleaners, on page 34 of this issue, is worth some serious thought. It is a comparison of the methods used by sixteen companies which were outstanding in cleaner sales last year. It is important, mainly, because it demonstrates how this appliance, so vital to the home, is now being neglected to a point where worn-out cleaners constitute a menace to customer good will. It involves a matter of policy that every power company could well check up right now.

It is easy to forget that from one angle the smaller the load an appliance entails the most important it becomes in domestic service, so long as it performs well. For to the householder, the greater the number of comforts and conveniences his family enjoys for his one, three or five dollars a month, the better he feels about it. On the other hand, out-of-repair cleaners do harm by breaking down good will. And since there are now millions of them, the situation calls for action. The fact that other appliances have more load value should not be permitted to interfere with cleaning up this situation.

· TRENDS ·

THE EDITORS USE A SPOTLIGHT ON CURRENT HAPPENINGS

Catch the Rebuilders

THOSE customers of a power company who are taking advantage of current inducements to rebuild and modernize their homes are logical prospects for education in the fuller use of electric service. The Dayton Power & Light Company, recognizing the possibilities in the present tendency toward modernization, are carrying the story of electrification to all who are building or remodeling homes in their territory. In a letter to each owner they carry a list of 28 suggestions aimed to insure an adequate wiring system in the new or revamped home which will provide for the fullest use of the electric service.

Catching Up

COMPANIES that have heretofore found it advisable to defer payment of dividends are catching up. A single day's news brings these items: Minnesota Power & Light resumes full payment on 7 per cent, 6 per cent and $6 preferred, after reducing quarterly payments to $1.31 on the first and $1.12 on the two latter, thereby cutting accumulations to ⅝ of a year. Arkansas Power & Light declared full quarterly dividends against the last payment of $1.17 on 7 per cent and $1 on 6 per cent preferred. Michigan Electric Power announced accumulation dividends of $0.87½ on 7 per cent and $0.75 on 6 per cent preferred, reducing the unpaid amounts to the equivalent of two years. Utah Power & Light announced accumulation dividends of $0.58⅓ on $7 and $0.50 on $6 no par preferred, likewise cutting the arrears to the equivalent of two years. Several of these companies serve mining regions. With increased demand for metals, power sales have been coming back—another illustration of the pervading influence of recovery in the basic industries, to which thoughtful students have been insistently calling attention.

Market for Off-Peak Devices

ALL 48 of the state rate reports now being available, the opportunity is afforded to find out where and how big the territory is in which water heating rates call for off-peak restriction. That constitutes the market for time switches, two-rate meters, two-heat units, carrier control, etc. It is no simple job to extract and compile this information, but we are at it and will have the answer shortly.

A Suggestion on Metering

"CAN there not be devised a satisfactory meter with a recording tape which would not easily be forged or tampered with, constructed in such fashion that the customer can, on a given date, withdraw the tape from the meter and mail it to the office with his check?" People's Counsel W. A. Roberts of the D.C. public utilities commission asks it and says it would reduce some of the excuse for (and the nuisance factor in) the service charge. He's a lawyer, so the answer will probably not come from him unless he is withholding something from us.

Favor the High-Pressure Style

A GREAT many utilities are seriously considering the matter of making their old generating plants more efficient and of greater capacity by the construction of high-pressure boilers and the use of high-pressure turbines exhausting into the existing low-pressure steam mains. This is the present style, but possibly it is not the best answer in all cases. A more logical approach is to make a complete analysis of power needs and power costs and of the available ways of getting more capacity and greater economy instead of simply following this "high-pressure" style. Too often engineers, like sheep, follow the bellwether. This is not good engineering.

Short-Wave Telephone System

ULTRA high-frequency radio waves are now available to form unattended links in a toll telephone system. Messrs. N. F. Schlaak and F. A. Polkinghorn described such a link between Green Harbor and Provincetown, Mass., in a paper before the Institute of Radio Engineers. This link forms part of a toll system to Boston and operates splendidly. Transmission is at 65 and 65 m.c. with a 1,000-cycle interrupted ringing circuit. Several months of traffic operation have brought up no important technical or operating difficulties. This new development may possibly have applications in other fields, such as a primary or reserve communicating method for widespread power utilities or for particular installations. Radio is advancing on all fronts these days.

U.G.I. Leads Revolt Against Registration

Directors of holding company, told by counsel law is invalid, vote to seek injunction to bar enforcement — Break ice for others to refuse S.E.C. control

The campaign against registration under the public utilities holding company act was crystallized into action on Wednesday when directors of United Gas Improvement Company, advised by counsel that the law is unconstitutional and "cannot be sustained," voted unanimously to seek an injunction against its enforcement in the United States District Court, Eastern District of Pennsylvania.

This action broke the two weeks of suspense which followed Judge Coleman's "illegal in its entirety" decision and paved the way for most of the other holding companies to seek writs enjoining the Securities and Exchange Commission from enforcing the law or levying penalties for non-compliance by the Dec. 1 deadline. It had been preceded by Philip H. Gadsden's statement that the utilities were "not just stubborn" but that "registration would be in effect an acceptance of the very provisions which the court has condemned." The S.E.C. cajoled—there was no "catch" in the registration form, Chairman James M. Landis promised—and threatened mildly: Why face disruption of operations or possible invalidation of pending financing?

Considered two courses

Yet it was common knowledge in Washington and in utility circles that very few of the big companies intended to register. Most of them considered two courses: (1) Starting injunction proceedings themselves, or (2) having a stockholder ask an order restraining them from registering. They received last minute encouragement in the fight from General Foods' chairman, E. F. Hutton, who told other industries to support the utilities or face New Deal regulation themselves if the Administration wins this foray.

At the same time, Bruce, Inc. (upholding constitutionality of the law in the Baltimore test case) had completed its plans for an appeal from Judge Coleman's decision and waited only the Court's approval to file in the United States Circuit Court of Appeals, action which is expected the first of next week.

Two of the large holding company systems, however, are reported to be ready to register. They are the $840,000,000 Associated Gas & Electric System and the $400,000,000 New England Power Association, the latter a subsidiary of International Hydro-Electric, which is, in turn, controlled by International Paper & Power. New England Power, if it registers, will stipulate that it is not waiving any of its constitutional rights.

New financing rushed

The present rush of new issues exemplifies the extent to which the subject of new financing is up in the air. Investment bankers are exerting all their energy to bring out deals, the registration certificates for which are effective, before December 1. After that date there is little doubt but that holding company financing for all but registrants will be barred until the Supreme Court rules on the act. Hence the last half of November probably will produce well over $200,000,000 of such financing.

In the meantime, it is agreed that operating companies will need new money for facilities necessitated by the power load, which, almost every week, reaches record highs. Wall Street is split on the status of such bonds, but some of the leading bankers finally have come to the conclusion that operating subsidiaries of non-registered holding companies will be able to finance legitimate needs with first mortgage liens. With this in mind, investment houses hope the companies' stand against registration has not offended the S.E.C. to the prejudice of such new issues.

Many seek exemption

Companies applying to the S.E.C. for exemption have been numerous. Among them was Pacific Lighting Corporation and its subsidiaries, stating that their business was entirely within the state of California. They noted specifically that the application was not to be construed as a waiver of constitutional rights.

Associated Gas continued in the last fortnight to consolidate properties further, General Public Utilities, Inc., has acquired all properties of Consolidated Power & Light Company of South Dakota (it previously owned all stocks and bonds) and the Southwestern Power Company, another wholly owned subsidiary; investment trusts scrambled to cut holdings in any single utility to less than 10 per cent to avoid involvement under the act.

Ten-Year Program for R.E.A. Hinted

Expenditure of billion and a half to electrify half of nation's farms suggested by Cooke in answer to Senator George W. Norris

A vast program of rural electrification is economically and socially justifiable—half the farms in the country could be served through a $1,500,000,000 ten-year outlay—Morris L. Cooke, R.E.A. administrator, declared last week in a letter clearly hinting at what may become a long-term national policy.

The communication was Mr. Cooke's reply to Senator George W. Norris, who wrote the R.E.A. chief advocating far-flung extension of electric service to farms and raised the question of federal subsidies, if necessary, to drive the program to completion. The reply, coming after three weeks' delay and following several conferences between Mr. Cooke and President Roosevelt, was greeted as carrying considerable official significance.

Outlines federal policy

The broad outline of federal policy in Mr. Cooke's letter was clear. He declared that "the federal government alone has interests coextensive with the millions of rural customers and the many power producing and distributing units which would serve them, and only the government is in a position to exert the leadership to bring them together.

"It is my judgment that in this country federal participation in a comprehensive rural electrification program of long range rather than of a temporary work relief character is economically and socially justifiable. Under such a program as you have proposed it should be possible, according to our tentative estimates, to have 50 per cent of all rural homes electrified in ten years at a total investment, private and public, of $1,500,000,000."

Mr. Cooke described as "pitiable" the present situation, in which it is estimated only 11 per cent of the country's farms have electrical service, and outlined R.E.A.'s immediate goal as follows:

"If the Rural Electrification Administration can demonstrate that . . . economies are practicable and if we can be instrumental in doubling the number of rural consumers within the next year or two our expectations will be fulfilled."

Mr. Cooke agreed with Senator Norris

that the private utility companies are taking only the cream of the farm business and listed the following drawbacks in extension of service: (1) Prohibitive costs of line construction; (2) excessive demands on farmers for cash contributions for building lines; (3) high rates, which discourage abundant use of current, and (4) the policy of extending monopolistic franchises as widely as possible while extending service only in the profitable areas.

Much of R.E.A.'s planning has been directed toward demonstrating that the costs of rural service can be lowered by planning extensions to serve entire areas to secure the economies of mass production; by building lines on contract after competitive bidding; by lowering overhead and capital charges; by encouraging rates that promote abundant consumption, and by furnishing reasonable terms for the purchase of appliances.

Only by planning for a fairly complete coverage of an area, with as few gaps as possible, can the essential economies be realized, Mr. Cooke pointed out. He said that at least one-third of the billon and a half program he envisioned should be self-supporting.

Bids will be received on or about Dec. 1 by the Ohio Farm Bureau Federation, Columbus, Ohio, for labor and materials to construct 193 miles of rural distribution line in Miami County and 270 miles in Shelby County, both in Ohio. Estimated quantities are as follows:

	Miami Project	Shelby Project
Poles	3,800	5,400
Wire conductors (miles)	580	810
Insulators	12,000	16,200
Transformers	365	562
Meters	700	1,000
Cost	$180,000	$250,000

Both projects are being financed through loans by the Rural Electrification Administration.

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Rural Electrification Projects

Details tabulated below on rural electrification projects were specially prepared by the R.E.A. for ELECTRICAL WORLD. The standards which the administration will set for line and equipment have not been finally determined due to the rush to complete approval of projects, and, when prepared, will be advisory rather than mandatory. In general, it is understood any good low-cost line will pass R.E.A. inspection.

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United States Leads World in Rural Electrification

There seems little possibility of the United States ever becoming backward in rural electrification, H. S. Bennion, assistant managing director of the Edison Electric Institute, states in a leading article in the current *Bulletin* of the institute, controverting federal government officials who have repeatedly characterized America as a "backward nation" in bringing electricity to the farm.

Morris Llewellyn Cooke, Rural Electrification Administrator at Washington, is quoted by Mr. Bennion as having widely broadcast statements to the effect that "only one farm in nine in this country is enjoying electric service . . . yet in Japan nine out of every ten homes are benefited by it; in Europe we find the leading nations far in advance of the United States in providing electrification for rural areas . . . in Sweden over 40 per cent of the farms are electrified."

Rural electrification abroad

Mr. Bennion cites evidence that electrification of homes in American states of denser population ranges from 95 to 98 per cent, in comparison with what is said to be the 90 per cent electrification in Japan—although the latter figure shrinks to minor importance because it includes the one-lamp-per-home electrification, which "is the standard for the vast majority of consumers" of Japan. In the American states of high farm density, 60 to 70 per cent of the farms are electrified as compared to Sweden's 40 per cent.

In Great Britain only 35 per cent of all homes were electrified as late as 1934 and rural electrification on any appreciable scale in that country has only begun. In Canada 10 per cent of all farms have electric service. Ontario leads with 17 per cent, whereas across the line in New York State 36 per cent are electrified. In France, in 1927, less than 40 per cent of all homes had electric service, consisting principally of a limited amount of lighting, as contrasted with 80 per cent in American states of comparable density.

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Permanent P.W.A. Urged By Resources Committee

Planning should not be too greatly centralized in Washington, but should have its beginning in the work of the states, in the opinion of the National Resources Committee, expressed in a 300-page report on State Planning submitted to President Roosevelt by Chairman Harold L. Ickes and made public this week.

"Too great centralization in Washington is not desirable even if possible," the report stated, "since planning is an attitude and a practice which must command the confidence and invite the co-operation of wide groups of people; it must come from the bottom up as well as from the top down."

Among the recommendations contained in the report was the following: "We recommend that the state boards consider carefully among other possibilities the plan suggested by the National Resources Board in its report of December, 1934, for the establishment of a permanent public works administration. The arrangement proposed would provide for a continuing organization to deal with the co-ordination of a wide range of federal public works projects on a technical basis, but would also enable this agency to take the lead in the co-ordination both of state and federal works programs over a period of years. . . ."

Details of Rural Electrification Projects

	Miles of Line	Farms Served	Amount	Power Source	Retail Rate*	Territory
1. Indiana State-wide Rural Electric Membership Corp., 504 Farm Bureau Bldg., Indianapolis, Ind.	587	2,200	$567,926	(2)	$4.95	Boone County, Ind.
2. City of Dayton, Tenn.	38.9	215	38,058	T.V.A.	3.50	Rhea County, Tenn.
3. Roosevelt Rural Public Power District, Mitchell, Neb.	226.5	839	310,000	Munic.(1)	5.50(3)	Scotts Bluff and Sioux Counties, Neb.
4. Gering Valley Rural Public Power District, Gering, Neb.	47	143	65,000	Munic.(1)	5.50(3)	Scotts Bluff Co., Neb.
5. Miami Rural Electric Cooperative, 620 East Broad St., Columbus, Ohio.	193	690	254,000	Munic.	4.80(3)	Miami County, Ohio
6. Bartlett Community Light and Power Company, Bartlett, Texas.	30	110	33,000	Munic.	5.11(3)	Bell and Williamson Counties, Texas
7. Central Iowa Power Company, 114 Eleventh St., Des Moines, Iowa.	3	50	6,100	Private	5.04	Dallas County, Iowa
8. South Carolina Rural Electrification Authority, Columbia, S. C.	511	2,128	542,328	Private	4.65	22 counties in S. C.
9. Shelby Rural Electric Cooperative, 620 East Broad St., Columbus, Ohio.	270	1,005	350,000	Munic.	4.80(3)	Shelby County, Ohio
10. Monroe County Electric Power Association, Amory, Miss.	55.3	361	81,000	T.V.A.	3.50	Monroe County, Miss.
11. Meigs County Electric Membership Corporation, Decatur, Tenn.	78.6	545	92,200	T.V.A.	3.50	Meigs County, Tenn.

*Monthly charge for first 100 kw.-hr. In all cases additional current has much lower unit cost.

(1) Power purchased at cost from municipal plants in territory, which in turn buy it from the U. S. Reclamation Service.

(2) Several sources available; no choice yet made.

(3) Tentative rate subject to adjustment when cost of line and amount of load shall be finally determined.

NOTE: Two additional allotments have been announced, but, because both projects are under court injunction, no contracts have been signed: (1) $700,000 to Imperial Irrigation District, California, for 497 miles of line connecting about 1,500 farms. (2) $295,000 to Southern Sierras Power Company for a second project in the Imperial Valley serving about 600 farms through approximately 200 miles of line. Both will ultimately secure power from hydro-electric plants now being built along the All-American Canal.

North American Drops Plan to Sell Washington Holdings

District of Columbia Commission moves to limit operating property to 6 per cent return, balking simplification of holding company despite federal campaign to force integration or liquidation

The government's campaign against holding companies ran into an unexpected reverse last week when a large holding company's effort to divest itself of an important operating property was balked by a quasi-federal commission. This paradoxical situation arose when the North American Company announced its intention of selling its holdings in Washington Railway & Electric Company stock to underwriters for public offering.

With the stock registration statement filed for Securities and Exchange Commission approval, the Public Utilities Commission of the District of Columbia announced that it shortly would consider the rates of Potomac Electric Power Company, principal subsidiary of Washington Railway & Electric. Consideration of rates normally would not have been due until January, but its injection at this juncture rendered the matter of earnings so problematical that North American went back to the S.E.C. with a request to withdraw the registration certificate. This would leave the holding company's position in Washington unchanged.

Potomac Electric operates under a sliding scale of rates. Whenever income is over 7 but less than 8 per cent, one-half of the excess must be used the next year to reduce rates. If the annual yield is more than 8 but less than 9 per cent, three-fourths of the excess must be used to cut rates, and above 9 per cent five-sixths must be turned back. The commission strongly hinted in its order for reconsideration of rates that it may seek to impose a 6 per cent base.

Withdrawal of the sale brought a blast from People's Counsel W. A. Roberts, who said: "I am not going to let them get away with that." Roberts charged North American, through its ownership of Washington Railway & Electric stock, and, in turn, of Potomac Electric, with violation of the La Follette anti-merger act. Now that the sudden turn in affairs puts North American back in control of the Washington properties, Roberts promises prosecution.

Cancellation of the deal was disappointing to many in that it left unanswered such questions as to why North American decided to withdraw from the District of Columbia, what plans had been made for the disposition of the proceeds of the sale and whether the stock would find its way directly to the public or if control might be acquired by some other utility system.

Washington advices were that the sale was contemplated as a part of compliance with the Public Utilities Act of 1935. The company, however, had given no indication that it intended to sell other properties. No announcement was made, either, as to application of the proceeds to purchase of other holdings, retirement of the debenture 5s or possible distribution to stockholders. As to the possibility of some other utility company taking a large block of the stock on the offering, capital circles heard no little gossip of the Associated Gas & Electric System stepping in and adding the Washington properties to its group of companies on the Atlantic Seaboard. This was never confirmed or denied.

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Ill Wind Blows Praise to Utility in Florida

Crews totaling more than 800 men worked from dawn to dusk for days repairing storm damage to electric transmission lines after Florida's latest hurricane and won for the holding company and service company set-up a word of praise in the 'Gator state's press. Miles upon miles of tangled wires and hundreds of poles snapped like matchwood created a tremendous job all the way from West Palm Beach to Florida City.

About 600 Florida residents were employed; 280 skilled men were rushed to Miami by automobile, train and airplane, some of them from points as far distant as Pennsylvania.

This was the job done by the Florida Power & Light Company, subsidiary of Electric Bond & Share, which, far from hiding its light under a bushel, inserted newspaper "ads" outlining the difficult character of the task, urging against impatience over delays, citing human incidents in the work, warning children and the public at large against touching live wires, and praising the parent company's financial and other aid which made possible undertaking the job within an hour after the end of the storm.

But perhaps the most appreciated words were those of the Miami *Herald*, which, while noting that the municipal ownership argument is "cogent" and "tempting," declared: "The effects of the hurricane this month may well give pause to promoters of this economic theory. Holding companies and their subsidiaries may be guilty of all the financial sins of which their opponents accuse them. But what community in this section would choose another system of ownership . . . which would place the tremendous burden of restoring light and power service on the communities already burdened with heavy bonded debt?"

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Pacific Gas Elects J. B. Black President

Directors of the Pacific Gas & Electric Company at a meeting held November 20 elected James B. Black as president to fill the vacancy created by the death of A. F. Hockenbeamer. Mr. Black has resigned as vice-president of North American Company and as vice-president and director of Western Power Corporation to assume his new duties. Mr. Black was one of the leading figures in the electrical industry on the Pacific Coast when in 1926 he was appointed to the New York organization of the North American Company as vice-president of the Western Power Corporation of New York. The following year he was elected a vice-president of the North American Company.

Following graduation from the University of California in 1912, Mr. Black became identified with the Great Western Power Company's commercial department. Subsequently he was appointed assistant to the general agent, acting manager of the San Francisco division, general sales manager, acting general manager and then general manager. In 1922 he was promoted to the executive position of vice-president and general manager, the position he occupied until his transfer to New York. While in the West Mr. Black devoted considerable time to the affairs of the Pacific Coast Electrical Association, of which he is a past-president, and was also active in other electrical societies.

Announcement was made in San Francisco that no other changes in present management of the company are planned.

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Supreme Court Sets Date for T.V.A. Argument

Following the request of the government to speed final decision, the Supreme Court this week set December 19 as the date for argument on validity of the Tennessee Valley Authority Act. In asking that T.V.A. arguments be advanced, the government brief said that "because of the importance of the matters which have been brought in question, and the fact that the Circuit Court of Appeals has stayed its mandate, the Tennessee Valley Authority is handicapped in its administration, pursuant to the Tennessee Valley Authority Act, of the property committed to it by that act."

Seven-Point Plan Outlined For World Power Conference

At the first meeting of the executive committee of the World Power Conference, held in Washington November 19, an agenda was adopted, the appointment of eight subcommittees decided upon and a general plan of operation adopted.

Seven principal topics of discussion were approved, subdivided into eighteen specific questions. Each nation participating will submit one paper on each question which will present its views, except that on questions of a controversial nature each nation may submit two papers presenting opposite sides. All nations have been invited to participate and about 50 are expected to do so, sending approximately 1,000 delegates. Americans attending are expected to number 3,000.

Topics to be discussed are as follows: (1) Physical and statistical basis of the National Power Economy — technical, economic and social trends; (2) organization of the fuel industries; (3) organization and regulation of electric and gas utilities; (4) national planning for most efficient utilization of natural resources; (5) problems in regional planning; (6) rationalization of distribution, and (7) national policies.

Eight subcommittees were authorized. It was decided to co-operate with the American delegates to the Chemical Engineering Congress to be held in London, England, June 22-27. J. C. Bonbright was added to the executive committee.

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Electrical Development League Is Organized

Organization of the Electrical Development League of Southern California to co-ordinate all phases of the electrical industry in southern California was announced recently at a meeting of the Los Angeles Electric Club. The league, representing every branch of the industry, has for a primary purpose the development of the electrical products market for beneficial use of Boulder Dam power when it becomes available.

The administration of the league will be by a board of trustees made up of the various interests in the industry. Those on the first board are: M. G. Sues, Leo J. Meyberg Company, representing electrical appliance distributors; Will H. Davie, Allied Industries, Inc., for electrical manufacturers' agents; A. L. Stone, Stone Electric Supply Company, for electrical contractors; Fred B. Lewis, vice-president and general manager Southern California Edison Company; Burdette Moody, business agent, Los Angeles Bureau of Power and Light; A. E. Hitchner, Westinghouse Electric & Manufacturing Company, for electrical manufacturers; F. C. Todt, General Electric Supply Corporation, for electrical wholesalers; John C. Holland, Holland Electric Shop, for the Electrical Retail Association, and Van Pender, Barker Brothers, representing the Los Angeles downtown stores.

The officers are Mr. Sues, president; Mr. Davie, vice-president, and Mr. Stone, secretary-treasurer. F. L. Hockensmith is general manager.

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Former Insull Utilities Divorce Managements

Plans to separate Commonwealth Edison Company and Peoples Gas Light & Coke Company, operating companies of the former Insull system in Chicago, came to light this week when James Simpson, chairman of both, quit his Peoples Gas job and George A. Ranney resigned as vice-chairman of Edison to succeed to the post thus made vacant. While Mr. Simpson declared the shifts were not dictated by the Public Utility Act of 1935, it was made clear that plans are under way to end duplication in the directorates after seventeen years of unified management.

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All Power Companies Invited to Compete for Coffin Award

Invitations are being extended this month by the prize awards committee of the Edison Electric Institute, Frank W. Smith, chairman, to all electric light and power companies operating in the United States to compete for the Charles A. Coffin Medal for 1936. Under the terms of the Charles A. Coffin Foundation as established by the General Electric Company, the Charles A. Coffin Award will be made to that company which during the year 1935 has made a distinguished contribution to the development of electric light and power for the convenience of the public and the benefit of the industry.

Presentations of accomplishments by companies desiring to compete for the award are to be made not later than April 1, 1936. The presentation of the award will be made at the 1936 convention of the institute. In addition to the Charles A. Coffin Medal, the award carries with it a gift of $1,000 for the employees' benefit fund of the winning company.

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Neff Insists on Sanity in Rural Electrification

"It is true that less than 15 per cent of the farms of the nation now have electric service and it is the hope and wish of every one connected with the development that lines will be built as rapidly as practicable to extend this service to additional farms. But it is also the hope and wish of the people who have been most closely associated with this movement that it proceed on the sane, orderly and sound basis on which it has reached its present status. It will be most disastrous if wishful thinking leads this development into channels where serious mistakes will be made which will be costly, not only to those who make the utility investment but to the farm users as well."

In these words Grover C. Neff, president Wisconsin Power & Light Company, and for years past a recognized leader in rural electrification, speaking at the convention of the Indiana Electric Association, Purdue University, November 7 and 8, registered protest against the tendency, more than apparent these days, to subsidize electric service to the American farmer. The points of the address were that efforts to make the city man pay for the farmer's electricity must be productive in the end only of disaster, and the self-respecting farmer does not want any one to pay his bills for him.

Rural electrification loomed large at the convention; one regular session was given over to it and there were three supplemental rural electrification sessions for those who wanted to remain for the concert after the big show. Taxes, rates, metering, housing and air conditioning were among the subjects treated in the other sessions. About 300 attended the convention.

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Heat Transmission

A symposium on heat transmission is to be held at Yale University December 30 and 31 under the auspices of the Chemical Engineering Department. Speakers include several university professors and industrial engineers, among them R. A. Bowman of Westinghouse and E. N. Sieder of Foster-Wheeelr.

COMING MEETINGS

Arkansas Utilities Association—Annual convention, Arlington Hotel, Hot Springs, Ark., November 25-26. R. E. Ritchie, secretary-manager, Arkansas Power & Light Company, Little Rock, Ark.

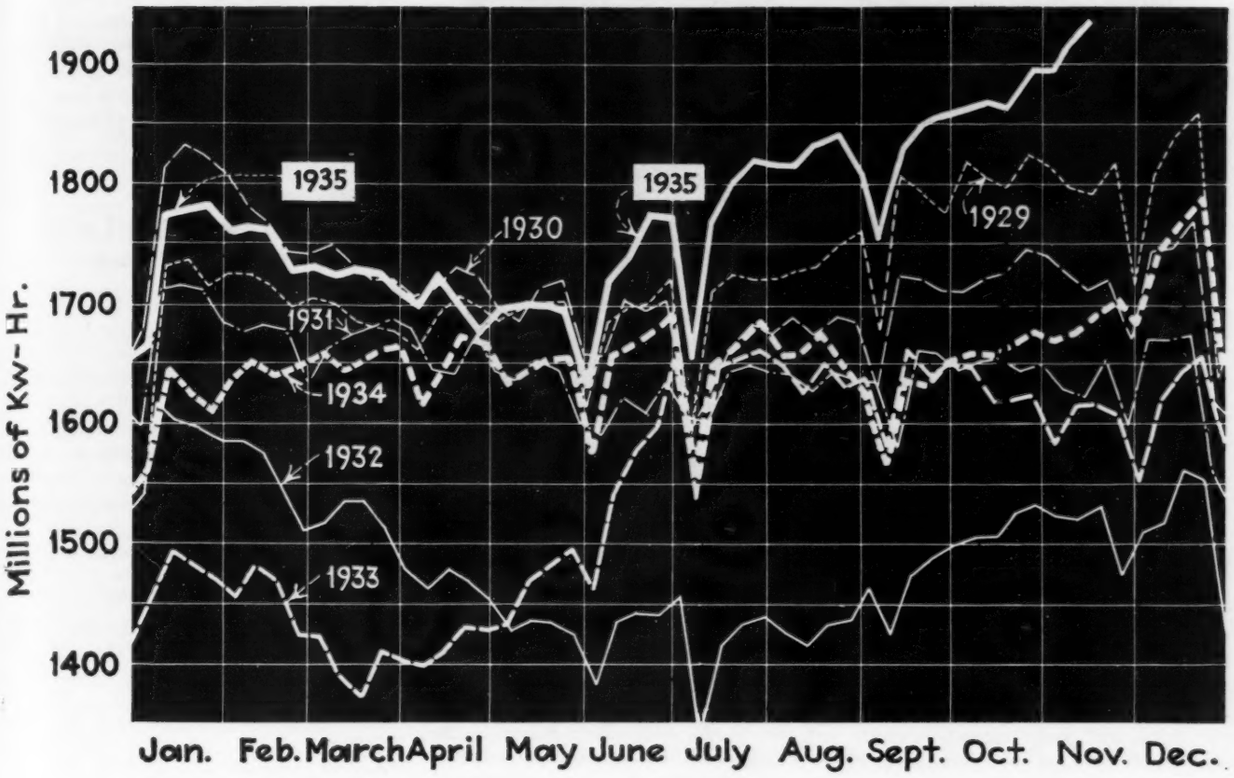
American Physical Society — Johns Hopkins University, Baltimore, Md., November 29-30. W. L. Severinghaus, secretary, Columbia University, New York, N. Y.

American Society of Mechanical Engineers—Engineering Societies Building, New York, N. Y., December 2-6. C. E. Davies, national secretary. 29 West 39th Street, New York, N. Y.

American Engineering Council—Annual meeting, Washington, D. C., January 9-11. Frederick M. Feiker, executive secretary, 744 Jackson Place, Washington, D. C.

American Institute of Electrical Engineers—Winter convention, New York, N. Y., January 28-31. H. H. Henline, national secretary. 33 West 39th Street, New York, N. Y.

Week's Output 8 per Cent Above 1929



Electrical energy production continues to increase, and to do so at an accelerated rate. For the week ended November 16 the output of central stations rose to 1,938,560,000 kw.-hr., according to the Edison Electric Institute, thereby surpassing the corresponding figure for 1934 by 14.6 per cent and of 1929 by 8 per cent, overshooting the peak of 1929 by 4 per cent and establishing a new all-time maximum 25,000,000 kw.-hr. higher than the record attained only a week earlier.

Although an upward tendency was manifested at least as long ago as last spring, in the form of a diminution of the usual decline in production at that season, the actual rise began in June. Since that time the movement has been continuously and vigorously upward, interrupted only by holidays. More recently there has been an added upward turn, so that the curve for 1935 is drawing away from both 1929 and 1934. In June the lead over the former year was around 3 per cent and over the latter about 6 per cent.

Weekly Output, Millions of Kw.-Hr.

1935	1934	1933
Nov. 16...1,939	Nov. 17...1,691	Nov. 18...1,617
Nov. 9...1,914	Nov. 10...1,676	Nov. 11...1,617
Nov. 2...1,897	Nov. 3...1,669	Nov. 4...1,583
Oct. 26...1,896	Oct. 27...1,677	Oct. 28...1,622
Oct. 19...1,863	Oct. 20...1,668	Oct. 21...1,619
Oct. 12...1,867	Oct. 13...1,657	Oct. 14...1,619

Per Cent Change from Previous Year

Region	Week ended Nov. 16	Nov. 9	Nov. 2
New England.....	+16.7	+14.2	+14.1
Middle Atlantic....	+10.8	+ 9.7	+10.7
Central Industrial..	+21.4	+20.4	+18.7
West Central.....	+17.4	+12.6	+10.4
Southern States....	+10.7	+11.6	+ 8.7
Rocky Mountain...	+17.9	+17.7	+26.0
Pacific Coast.....	+12.8	+12.5	+14.7
United States.....	+14.6	+14.2	+13.7

Detroit Edison Annexes Michigan Electric Company

The Detroit Edison Company has absorbed the properties of the Michigan Electric Power Company and will continue their operation under the present personnel at its Lake Huron Division. With the completion of the transfer, Detroit Edison is operating in its own name some 7,400 square miles of contiguous territory in southeastern Michigan, running from the tip of the "Thumb" in Lake Huron south nearly to the Ohio State line.

Just before the formal consolidation, E. L. Edwards, president of Michigan Electric, announced the redemption of its 6 per cent preferred stock at $117.75 a share and the 7 per cent preferred at $119.875, both including overdue dividends. The underlying mortgage bonds of Central Power Company of Bad Axe, a predecessor, were taken up at $101, as of January 1, 1936.

All of the Michigan Electric common was purchased by Detroit Edison June 30, last. For several years the major power requirement of Michigan Electric had been purchased from the Edison system. The transfer adds about 13,000 customers for Detroit Edison in some twenty towns.

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Output Sets New Record

Electric output of Public Service Electric & Gas Company set an all-time high for a single day on October 30 at 7,907,620 kw.-hr., while a new peak load for this year was recorded the same day when demand on the generating stations reached 508,100 kw. at 5:45 p.m. The load had not exceeded 500,000 kw. since December, 1930.

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Two United Directors Quit

Resignation of Edward Hopkinson, Jr., of Drexel & Co., and Alfred L. Loomis, of Thorne, Loomis & Co., from the United Corporation board in the simplification of that concern's directorate, in progress for some months, was announced last week. Thomas H. Stacy, assistant secretary, has been elected a director.

Utility Stocks Continue Advance

In a brisk market, light and power stocks advanced substantially this week. "Electrical World" index, 34.0; last week, 33.2

Utility Financing Heavy

Public utility companies resumed financing this week on a large scale.

Kansas Power & Light Company made an offering of first mortgage 4½ per cent bonds, amounting to $30,000,000, the price being 103 and accrued interest. Proceeds will be used for refunding, acquisition of properties and for other corporate purposes.

A new issue of $5,000,000 of Iowa Southern Utilities Company in the form of first and refunding mortgage 5½ per cent bonds was offered this week.

Public offering was made of a new issue of $22,799,000 Department of Water and Power of the City of Los Angeles electric-plant revenue 4 per cent refunding bonds of 1935. Proceeds from the sale will be used to refund a debt owed to the Reconstruction Finance Corporation.

Los Angeles Gas & Electric Corporation issued $40,000,000 of first and general mortgage 4 per cent series bonds due in 1970, priced at 102 per cent and accrued interest. Net proceeds from the sale, together with other funds of the company, will be applied to the redemption of $37,182,000 outstanding bonds consisting of seven separate issues.

Ohio Edison Company made an offering of first and consolidated mortgage bonds 4s, due 1965, to the amount of $43,963,500. The bonds were priced at 100½ per cent and accrued interest. Net proceeds from the sale of the $43,963,500 series of 1935 bonds (estimated at $42,913,348 after deducting expenses), together with other treasury funds, will be used by the company to provide funds for the redemption of the $40,115,500 outstanding underlying bonds and to reimburse its treasury for $3,848,000 underlying bonds retired or redeemed.

Last week Central Maine Power Company made an offering of first and general mortgage bonds, series G, 4 per cent, due 1960, a piece of financing involving a total of $15,600,000. The bonds were priced at 99 per cent and accrued interest. Proceeds from the sale of the bonds, with other funds of the company, will be applied to the redemption of $811,500 of twenty-year bonds, series B, 6 per cent, due in 1942; $12,750,000 of 30-year, series D, 5 per cent bonds, due in 1955, and $1,500,000 of 30-year, series F, 5½ per cent bonds, due in 1961. In addition an assumed issue of $175,000 of Oxford Electric Company 5 per cent bonds will be paid at maturity on January 1. The change, it was said, will cut annual interest charges to $1,374,000.

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Associated Servicing Units Put on Non-Profit Basis

Announcement was made last week by the Associated Gas & Electric Company that, through the formation of Utilities Mutual Management Association, Inc., the ownership of which will rest in the operating companies, the servicing companies of the Associated System are being placed on a non-profit basis in their relations with the operating companies.

New York Metal Prices

	Nov. 6, 1935 Cents per Pound	Nov. 20, 1935 Cents per Pound
Copper electrolytic	9.25*	9.25*
Lead, Am. S. & R. price	4.50	4.50
Antimony	14.75	14.00
Nickel ingot	35.00	35.00
Zinc spot	5.225	5.225
Tin Straits	51.75	51.50
Aluminum, 99 per cent	19—21	19—21

*Delivered Connecticut Valley.

Current Earnings Reports

Operating Companies

	1935	1934
Alabama Power (Year to Sept. 30)		
Gross earnings	$16,332,343	$15,425,055
Net balance	639,467	487,945
Consol. Gas Elec. Lt. & Pwr. of Baltimore (Year ended Sept. 30)		
Gross earnings	30,271,379	28,663,162
Net balance	4,944,482	4,635,551
Detroit Edison (Year ended Oct. 31)		
Gross earnings	48,116,163	44,544,012
Net balance	6,794,651	6,879,487
Georgia Pwr. (Year to Sept. 30)		
Gross earnings	23,070,738	22,077,693
Net balance	1,460,900	1,023,672
New Orleans Pub. Serv. (Year ended Sept. 30)		
Gross earnings	15,188,391	15,000,028
Net balance	193,143*	277,900*
Penn. Pwr. & Lt. (Year ended Sept. 30)		
Gross earnings	34,606,742	33,846,683
Net balance	4,594,604	5,314,601
Phila. Elec. (9 mos. ended Sept. 30)		
Gross earnings	47,749,339	46,141,888
Net balance	14,248,104	14,361,509
Puget Sound Pwr. & Lt. (Year to Sept. 30)		
Gross earnings	13,643,563	13,089,229
Net balance	1,336,385*	1,527,536*
So. Calif. Edison (Year ended Sept. 30)		
Gross earnings	37,054,165	35,910,129
Net balance	11,931,668†	10,402,006†
Union Elec. Lt. & Pwr. (No.) (Year to Sept. 30)		
Gross earnings	27,408,515	26,504,963
Net balance	4,930,527	3,757,530
Virginia Elec. & Pwr. (Year to Sept. 30)		
Gross earnings	15,232,223	15,011,340
Net balance	1,625,253	1,464,324

Holding Companies

	1935	1934
Amer. Gas & Elec. & subs. (Year to Sept. 30)		
Gross earnings	$69,836,343	$66,804,069
Net balance	8,074,373	7,299,837
American Pwr. & Lt. & subs. (Year ended Sept. 30)		
Gross earnings	81,288,935	74,913,644
Net balance	6,923,129	3,288,798
Amer. Water Wks. & Elec. & subs. (Year ended Sept. 30)		
Gross earnings	47,020,069	45,315,233
Net balance	1,883,661	1,857,039
Commonwealth & Southern & subs. (Year ended Sept. 30)		
Gross earnings	119,048,787	113,665,678
Net balance	491,406*	921,774*
Elec. Pwr. & Lt. & subs. (Year ended Sept. 30)		
Gross earnings	76,454,767	72,834,891
Net balance	47,032	287,434*
Engineers Public Service & subs. (Year ended Sept. 30)		
Gross earnings	45,402,226	44,002,229
Net balance	1,257,832*	1,457,909*
North American & subs. (Year ended Sept. 30)		
Gross earnings	109,891,445	106,960,190
Net balance	10,594,291	8,709,562
Pub. Serv. of N. J. & subs. (Year ended Sept. 30)		
Gross earnings	119,708,399	119,786,727
Net balance	24,330,801†	25,119,888†
United Gas Improvement & subs. (Year ended Sept. 30)		
Gross earnings	100,924,882	98,553,420
Net balance	26,204,910	27,691,551

*Deficit. †Available for all dividends.

Gross earnings—(Operating Companies) Gross operating revenue. (Holding Companies) Gross operating revenue plus other income. Net balance—Balance available from income for common stock dividends.

MANUFACTURING AND MARKETS

Optimism General as Recovery Persists

Favorable

"Breathing spell" called permanent.
Industrial indexes all favorable.
Holiday trade boom promised.
Trade pact aids electrical goods.
Load at 100,000,000,000 kw.-hr. a year rate.

Unfavorable

S.E.C. may bar utility financing.
Bankers, New Deal in open war.
League sanctions upset exporters.
U. S. budget cut insignificant.
Threat of inflation more evident.

N.E.M.A.'s 1936 Program Widens Scope of Service

Dropping all activities which might be construed as influencing price competition, in deference to a Federal Trade Commission complaint, N.E.M.A. nevertheless announces an ambitious 1936 program of services designed to lend impetus to the business of members. The list of functions proposed includes close attention to federal, state and local legislation, with information to members in regard thereto; advisory information on tariff agreements, advertising and publicity information, insurance, statistics and accounting; standardization of codes and standards, including safeguarding members' interests in connection with fire and safety regulations, and co-operation with architects and builders as well as governmental agencies to aid expansion of business.

In the light of this program, N.E.M.A. already has joined a group of fifteen trade associations in the building field in asking the federal government to clarify its housing plans.

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Electric Manufacturers Benefit From Trade Pact

The chorus of protest against the United States-Canada reciprocal trade treaty need expect no support from manufacturers of electrical equipment, trade leaders were agreed after a hasty glance at the list of articles on which duties were reduced by both parties. Scarcely any new competition for factories in the United States is indicated, the only item of note on which Canada gets a reduction being electric cooking stoves, on which the impost is cut to 25 from 35 per cent. Indicated imports are "small."

On the side of United States exports treated more favorably, however, there is a long list of electrical products, ranging from wire and copper and brass manufactures through vacuum cleaners and electrical refrigerators. Indicated annual shipments across the northern border in these classifications run around $40,000,000 and reductions in some duties are fairly deep. Electrical motor tariffs, for example, with an annual business of more than $4,000,000, are cut to 30 from 37½ per cent. Telephone and radio apparatus in general is cut to 25 from 30.

Vacuum cleaners will enter Canada on a 20 per cent payment, against 25.

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Refrigerators Lead Exports

Exports of electrical goods during September were valued at $6,515,114, according to a preliminary report issued by the Electrical Division of the Department of Commerce. Leading buyers were: Canada, $820,663; United Kingdom, $467,256; Mexico, $455,368; Union of South Africa, $453,501; Brazil, $403,719; Argentina, $281,931; France, $278,425. Exports of refrigerators and parts were valued at $1,128,480, of which about 20 per cent went to South Africa.

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Trade Broadens Part in Housing Exhibits

The electrical equipment industry's part in the Federal Housing Administration's better homes campaign has been broadened to include, in addition to appliances, etc., provided in the model houses, a "broadcast" over the "Talking Towers" in each exhibit. F.H.A. adopted these pylons to reproduce transcriptions during the home shows, the talks covering modernization loans, insured mortgages, advantages of modern electrical appliances and wiring, and other topics. The "Talking Towers," 17 ft. high and 3½ ft. in diameter, are designed to be heard only within a 6-ft. radius so as not to disturb visitors in other parts of the exhibit.

SWOPE INSPECTS G.E. PLANTS IN CLEVELAND

New developments in lamps for highway safety lighting received the particular attention of Gerard Swope, president of General Electric Company, on his recent visit to the Cleveland laboratories and manufacturing branches. Mr. Swope is shown with several of his Ohio executives, seated between George J. Chapman, new manager of G. E. specialty appliance sales (left) and J. E. Kewley, G. E. vice-president

"Better Light-Better Sight" Spreads to Foreign Lands

That the Better Light-Better Sight theme, which originated in this country, has been taken up abroad and is being repeated among peoples throughout the world is clearly evidenced by samples of "seeing" literature being received from foreign lands by the incandescent lamp department of the General Electric Company at Nela Park, Cleveland.

From the Argentine, Madrid, Berlin, from far-away Japan have come buxom, colorful brochures bulging with promotional literature featuring the Science of Seeing story as well as light-measuring and light-prescribing devices conceived and developed in the United States.

Literature emanating from these countries reflects in no small measure the profound influence of the Science of Seeing and the resultant Better Light-Better Sight movement on the lighting sales approach used in these distant lands.

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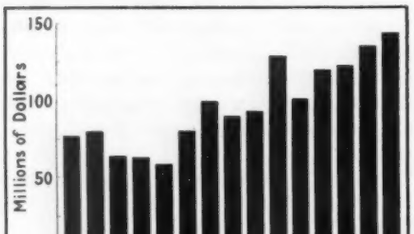
Electrical Orders Double 1932 Values



Orders for electrical goods reached a higher value in the third quarter of 1935 than in any other equal period since the summer of 1931. The total for 78 manufacturers reporting regularly to the Bureau of the Census is announced as $141,691,889. This is an increase of 5 per cent over the $134,924,964 in the preceding quarter and 41 per cent over the $100,334,150 in the third quarter of 1934. Compared with the third quarter of 1932 the value increased by 124 per cent. A rise from the second to the third quarter is unusual; since 1928 it has occurred only once before, in 1933. Recent values are more than double those of the low period in 1932 and 1933, but are still only half as large as in 1929.

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'Round-the-Clock Sales Drive Eclipses Quota

Twenty-four hours which produced more than the usual peak season week was the recent achievement of the General Electric Specialty Appliance Department in a 'round-the-clock sales drive.

The merchandising experiment, which had as one aim sales to the usually little-contacted night workers, was launched with 7 o'clock breakfasts for salesmen throughout the country. All day pending sales were closed and appointments were made to see husbands in the evening after work. Then they opened up on the all-night workmen.

Totals were wired to headquarters in Cleveland and the figure mounted to $1,365,227. The goal was $500,000.

Field Reports on Business

Special reports to ELECTRICAL WORLD from field representatives reflect steady improvement in business and a high degree of optimism over the outlook for the next several months.

CHICAGO

Electrical business in the Chicago region continues to improve at a perceptibly accelerating pace, continuing the movement that started right after the N.R.A. decision last May. However, utility buying remains only a minor contributor to this improvement, still being confined to expendable materials and such capital equipment as distribution transformers, watt-hour meters, etc., required for growing domestic and small commercial loads. The principal supporters of the improved business tone are governmental and industrial buying, such as a recent $800,000 contract for the electrical equipment of a large cold rolling mill.

The effect of Judge Coleman's decision on the Public Utility Act of 1935 is apparent throughout the Middle West in a disposition among utilities to think about the need for system capacity, which, in some places, is acute. Inquiries on turbines, power house switchgear, large transformers and associated equipment are becoming quite frequent and indications are that there will be some real orders placed after the first of the year.

NEW ENGLAND

Sales of electricity and of equipment allied with its production and marketing are steadily rising. Boston Edison reports record outputs for its own system; New England Power properties and many others are making gratifying kilowatt-hour deliveries. Industrial power projects are lively, and one Boston engineering office reports four steam turbo-generator sales within a fortnight for clients. Three of these were 4,000-kw. industrial machines, and one was a 12,500-kw. unit for a Southern utility under this engineering management.

Manufacturers' sales agents are increasing their territorial coverage, and orders are widely diversified and scattered. Some improvement has been shown in electric appliance deliveries. Metal tube radio sets are moving faster and household conveniences are doing well. Electronic control is being utilized to operate sectional lighting installations in textile mill service. A large volume of small motor sales is being put through the books without exceptionally large single orders.

The B. F. Sturtevant Co., Boston, has received a large order for air-conditioning equipment for the new Department of the Interior building in Washington, D. C. The job includes 59 fans, 2,200 air-conditioning units, 42 air-washers and dehumidifiers, and fourteen large unit heaters. The Boston district this year will show a striking advance in air-conditioning, recent installations including eleven restaurants and night clubs, seventeen offices and stores, one barber shop, three residences, a hospital application, a mortuary and a broadcasting studio.

PACIFIC COAST

Holiday buying, both in the retail and wholesale field, is held to be responsible for the quickening of the business tempo on the Pacific Coast. Executives are confident that the upward trend will accelerate during the remainder of the year.

Governmental awards promise increased construction activities in the West. From P.W.A. San Francisco and Oakland have obtained a grant of over $3,000,000 for the construction of a site for the Bay Bridge Exposition by reclaiming, through dredging and filling, some 400 acres near Yerba Buena island. Elwood Mead, Bureau of Reclamation head, has announced plans for initiating the huge central California water project, for which an initial $15,000,000 has already been appropriated. Also using federal money for construction will be a 150-mile transmission line from Boulder Dam to Pinoche, Nev.

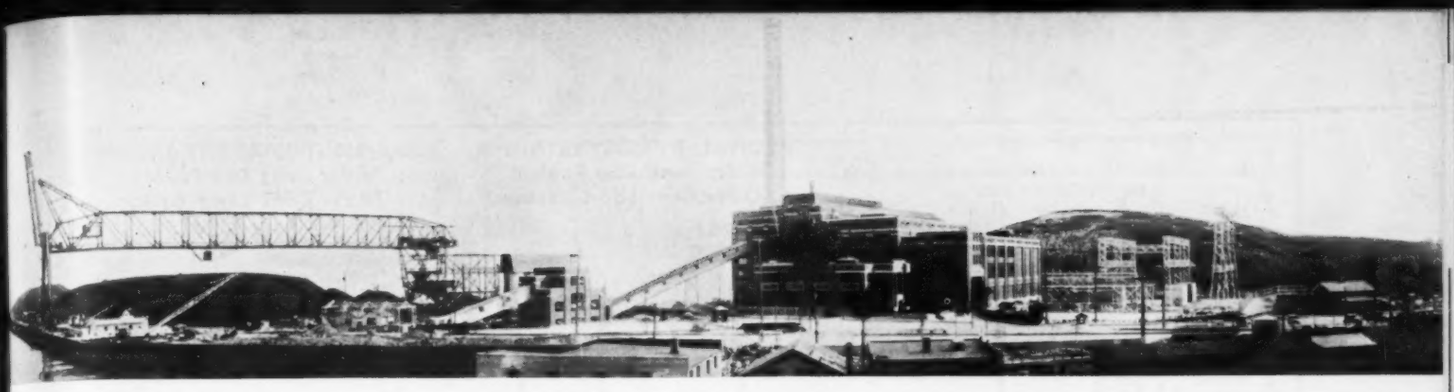
Private capital also contributes to the optimistic reports for future construction. General Motors is planning a $2,500,000 assembly plant in southern California. A large oil company is preparing to build a $250,000 lubricating oil plant.

The recent record-breaking days for many utility companies bears out the cheerful reports of earnings made so far this year. Both gross and net earnings for six reporting Western utilities so far this year are well ahead of 1934 and the continuing upward trend of output is having a marked effect in thawing out requisitions for new construction.

NEW YORK

Rising security prices, large gains over 1934 in all the industrial indexes and exceptional optimism over the outlook for holiday trade characterize the business situation as the year draws to an end. Automobile output figures, steel mill operations, railroad traffic reports, electric power production and bank clearings all tell the same story of continued improvement, despite the slight interruption of the Armistice Day holiday. Moreover, the long list of extra, resumed and initial dividends on important stocks bolsters the certainty of the best Christmas since 1930, probably since 1929. The spectacular rise in New York department store shares lends conviction to the fairly extravagant predictions.

Sentiment in the utility field is immensely improved due to the Baltimore decision against the holding company law, and, once court tests to invalidate registration with the S.E.C. are out of the way, substantial buying of generating equipment, etc., to meet the record load (the last few weeks of the year are confidently expected to set still higher marks) is anticipated. In the meantime expansion has hardly gone beyond the inquiry stage, but smaller equipment continues in brisk demand. Copper is steady.



Steam Station Cost Survey

Data on Investment and Operating Costs of Steam Power Plants Built Since 1927 — Guides for Building New Plants Indicated — Performance Data Show Thermal Gains

By L. W. W. MORROW

A RENEWAL of the building of steam power plants is indicated by the present upturn in load. Therefore data on investment and operating costs for recently built steam plants should afford a guide for building new capacity. In this article are presented these data on a representative group of stations built since 1927 as given to ELECTRICAL WORLD through the co-operation of utility executives. The data represent the investment in these plants when built and the operating costs for the year 1934. The stations range in size from 15,000 kw. to 200,000 kw. and include base load and standby stations. They include a wide range in pressure, temperature and size of units and use all available fuels. Thus, they give a representative cross-section of cost and performance for the newer steam stations in this country. An interesting comparison may be found in ELECTRICAL WORLD of October 27, 1928, which presents similar data on plants built in the 1921-27 era.

Any conclusions or comparisons from the data should be based upon four general considerations:

1. Many of these stations were designed for loads and load factors not realized in 1934.

2. In the high-pressure group there were included the developmental costs associated with this new advance in the art.

3. Each station was designed for its own local conditions and there may have been limitations due to this fact that do not show in the tabulated data.

4. New developments in the art and changed price levels in the present period may afford opportunity to improve the economic performance of the new stations to be built at this time.

Within these limitations some general deductions can be made about this group of representative steam stations:

1. During the past ten years a great reduction has been made in the fuel used per unit of output. The present stations to produce a kilowatt-hour for 12,000 to 13,000 B.t.u. were built for the same price as those built more than ten years ago to operate on 15,000 to 20,000 B.t.u. per kilowatt-hour.

2. The data on investment show that on an average, the first cost of this group of modern steam stations has not decreased appreciably in the past ten years when compared to a similar group of an earlier period. The cost per kilowatt of capacity is comparable to that of the group of stations built in the 1921-27 period. This statement applies only to these new stations and takes no account of improvements in old stations and the effect of interconnections.

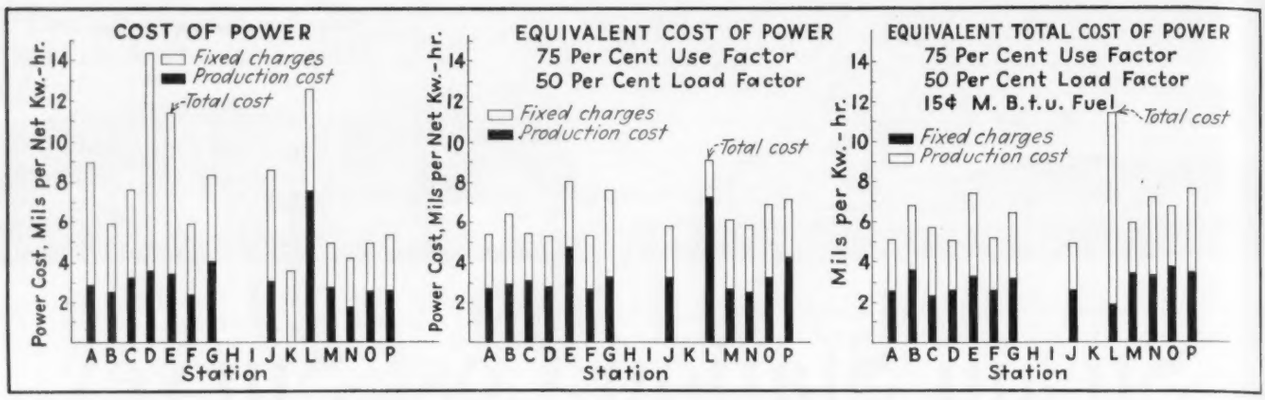
3. As shown in these data, for representative new stations the total cost of power per unit of output had not changed materially in ten years based upon operations in 1934 when compared to a similar group of plants in 1927. Apparently fuel costs, maintenance costs, wages and other cost increases offset the savings produced by improved thermal performance.

4. The data do not show any overall economic superiority of the high-pressure over the medium-pressure stations. It should be noted, however, that these high-pressure plants were built in a semi-developmental period and this conclusion may not be warranted today.

5. Size of station or generating unit, according to these data, is not a governing factor in the total cost of power. On the contrary, the data indicate that "building at the load" is a more economical principle than the old conception of the "super-power" station.

6. A large increase in the reliability of steam plant equipment is indicated

Detail investment and operating costs for sixteen modern steam stations are made available to the industry in this article through the co-operation of utility executives. These data should afford vital information to executives, engineers and equipment manufacturers who are busy with plans for adding new capacity to the operating systems.



Actual and equivalent cost of power in modern steam plants

and this may permit a reduction in the margin of reserve capacity needed in new stations.

7. Any large decrease in the cost of power must come from a reduction in first cost, greater hours' use of equipment and better load factors. In some degree, at least, the data show that the engineering of these stations stressed fuel economy too greatly and did not embody as the major goal a minimum value for the total cost of power. A greater degree of simplicity, more standardization and a larger use of the simple unit station would seem to be the approach to decreased first cost as well as a lower over-all cost of power.

Standards of Design—In the economic design of stations for given load factor conditions the major factors to consider are:

1. Fuel cost.
2. Cost of wages and superintendence.
3. Cost of maintenance and repairs.
4. Cost of the investment.

The chief costs are those of fuel and the fixed charges on the investment. It may be noted from the data that with all stations highly efficient and with a low range in fuel costs there is only a small opportunity to capitalize an increment fuel saving in terms of investment. The cost of fuel is not the governing design element in modern stations. Apparently this fact should be well considered in the design of some of the new stations. Too frequently the endeavor to get fuel economy is apt to dominate the design.

Heat-traps expensive

A refined, complicated station to get the minimum fuel consumption often increases the other cost items. Maintenance and repairs increase, wages and superintendence are larger and the investment increases quite rapidly. In addition the costs involved in special engineering studies and in the design and manufacture of special equipment are often in excess of the capitalized value of the increased reduction in fuel used.

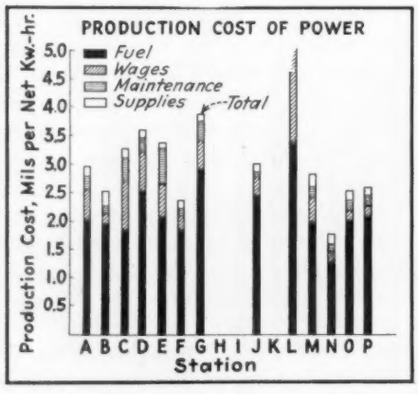
Apparently the best gage for the design of new stations is a full consideration of the load and use factors under which the station is expected to operate. And in this connection a very careful study should be given to making investments and plans in anticipation of future additions to the contemplated station. Shifts in load conditions and the rapid developments that occur in the art may dictate the building of complete unit stations a step at a time for individual locations as a more economical alternative. Of course if stations are fixed as to site location, this is not readily accomplished and it would seem best to use a structural arrangement that can be inexpensively adapted to a remodeling program in the future.

Total Cost of Power—In these representative stations the total cost of power in 1934 ranged from 4.17 mills to 14.35 mills per kilowatt-hour, with an average of 8.2 mills. The fixed charges range from 2.47 mills to 10.72 mills per kilowatt-hour, with an average of 4.9 mills. The production cost ranges from 1.70 mills to 8.10 mills per kilowatt-hour, with an average of 3.3 mills. Thus, about 60 per cent of the total cost of power is in the fixed charges and 40 per cent in the production charges. Fuel alone represents an average of 66 per cent of the production charges but only 27 per cent of the average total power cost.

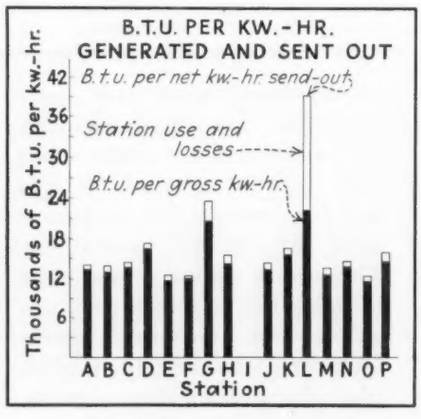
Thus, the average power cost is made up of 2.2 mills for fuel, 1.1 mills for wages, maintenance and supplies and 4.9 mills for fixed charges.

A study of the data, however, shows the wide variation in these costs as affected chiefly by load factor and the hours use of the equipment. Size of station or unit, however, shows very little correlation with the costs and the price of fuel holds remarkably well within a small range.

In order to reduce the variables the costs have been ratioed for 75 per



Large variations occur in production costs of steam power



Internal energy use is an appreciable item

cent use factor, 50 per cent load factor and a fuel cost of 15 cents per million B.t.u. Under these conditions the total cost ranges from 5.02 mills to 11.48 mills per kilowatt-hour, with an average of 6.6 mills. It will be noted that several individual stations have a much lower cost than this average under their actual operating conditions. On a normal property with diversified loads, however, stations operating at better load and use factors than those assumed are favored stations and carry an appreciable part of the system base load. The total cost of power in all cases is the cost of the net kilowatt-hours delivered to outgoing lines and includes the investment charges on the outdoor substations where these are used.

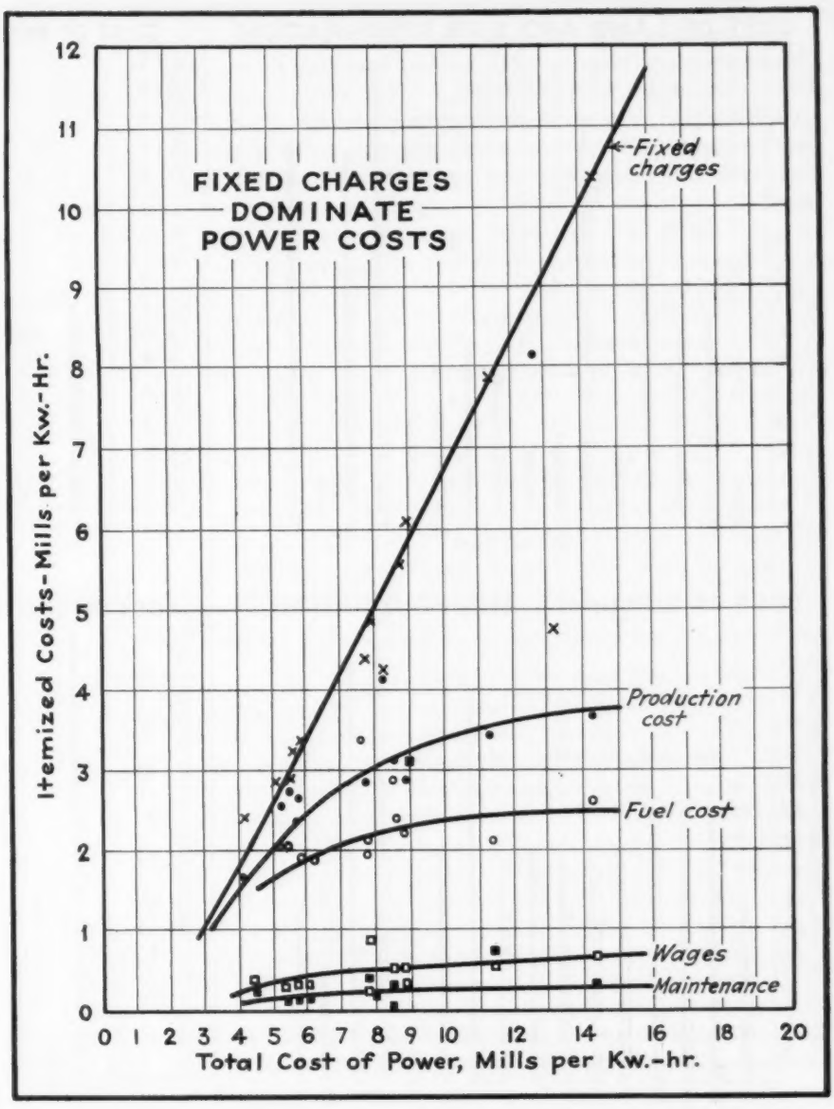
Operating Costs of Power—As has been stated, 1934 may not be a normal year of load for some of these stations and this is indicated in some of the data. It may also be noted that one or two stations are operated in conjunction with hydro systems as partial standby plants and another station includes exhaust steam use for other than generation, and this fact modifies its performance.

Coal cost quite uniform

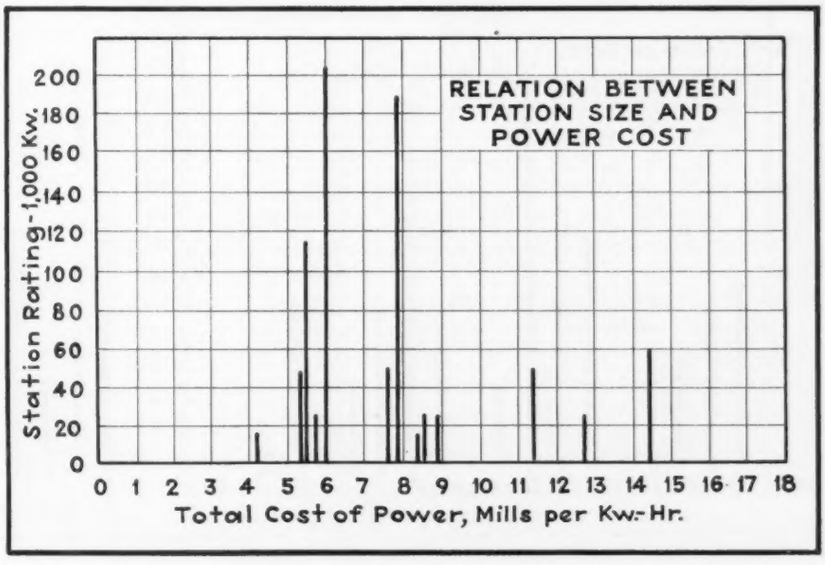
The uniformity in the cost of coal as fuel is noticeable both in mills per kilowatt-hour and in cents per million B.t.u. The range in all fuel costs in mills per kilowatt-hour is from 1.355 to 3.50, with an average of 2.2. On the basis of cents per million B.t.u. the range is from 8.85 to 17.45, with an average of 14 for all types of fuel used. It will be noted that this low range in fuel cost occurs despite a wide range in the net B.t.u. used per kilowatt-hour in these stations.

One controllable factor associated with station design is the cost of wages and superintendence. For these stations this cost ranges from 0.19 mill to 0.86 mill per kilowatt-hour, with an average of 0.43. The ratio of employees per 1,000 kw. is interesting to study in relation to these costs. It will be noted that no valid deductions as to this cost can be made in terms of the size of station, the pressure used or the B.t.u. per kilowatt-hour performance. It seems fair to say, however, that good practice should bring this figure down to 0.3 mill or less per kilowatt-hour in newly designed stations.

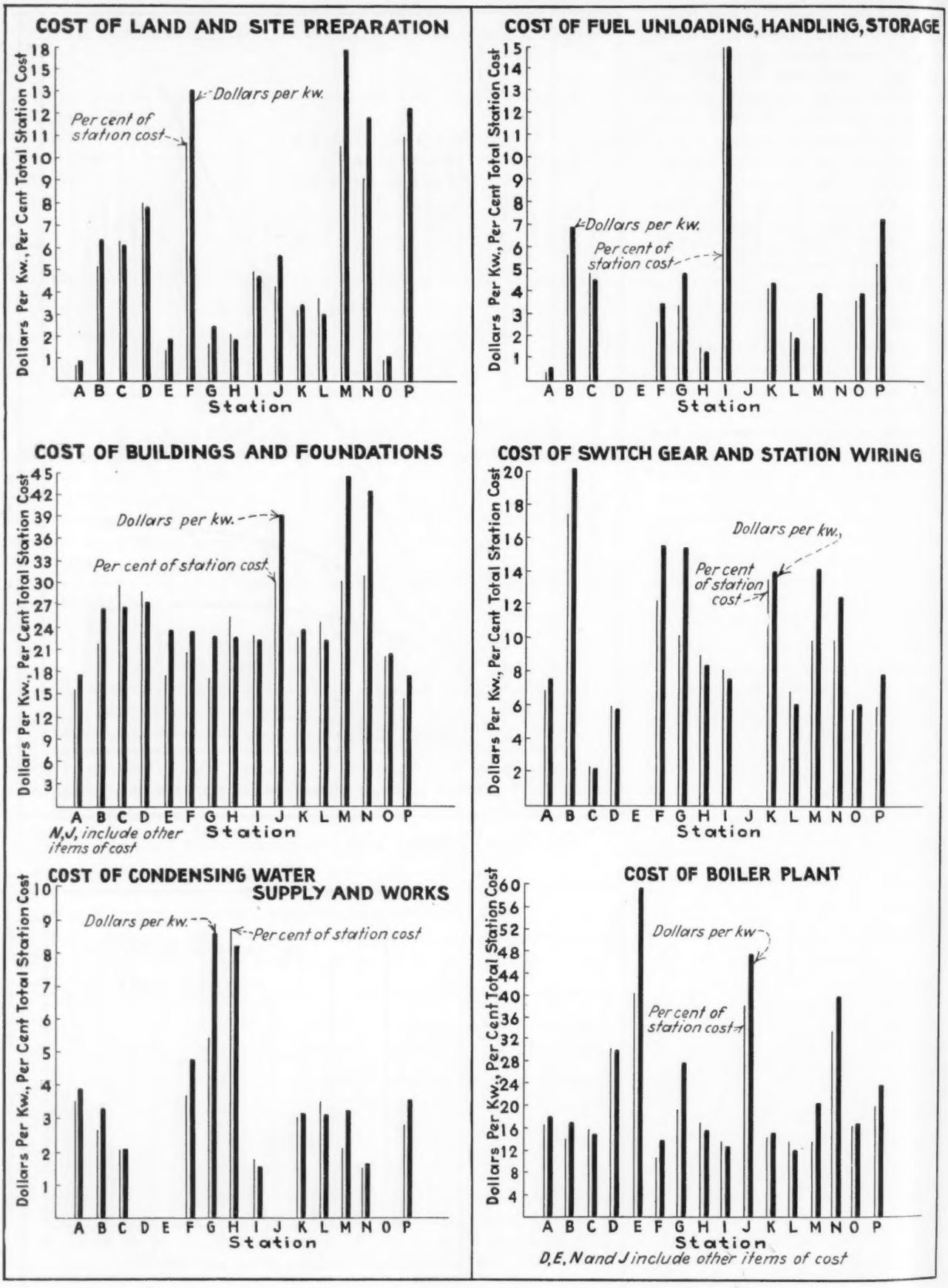
Waste, lubrication and supplies involve small costs, but it will be no-


FIXED CHARGES DOMINATE POWER COSTS
Fixed charges
Production cost
Fuel cost
Wages
Maintenance
Itemized Costs-Mills per Kw.-Hr.
Total Cost of Power, Mills per Kw.-hr.
0 1 2 3 4 5 6 7 8 9 10 11 12
0 1 2 3 4 5 6 7 8 9 10 12 14 16 18 20

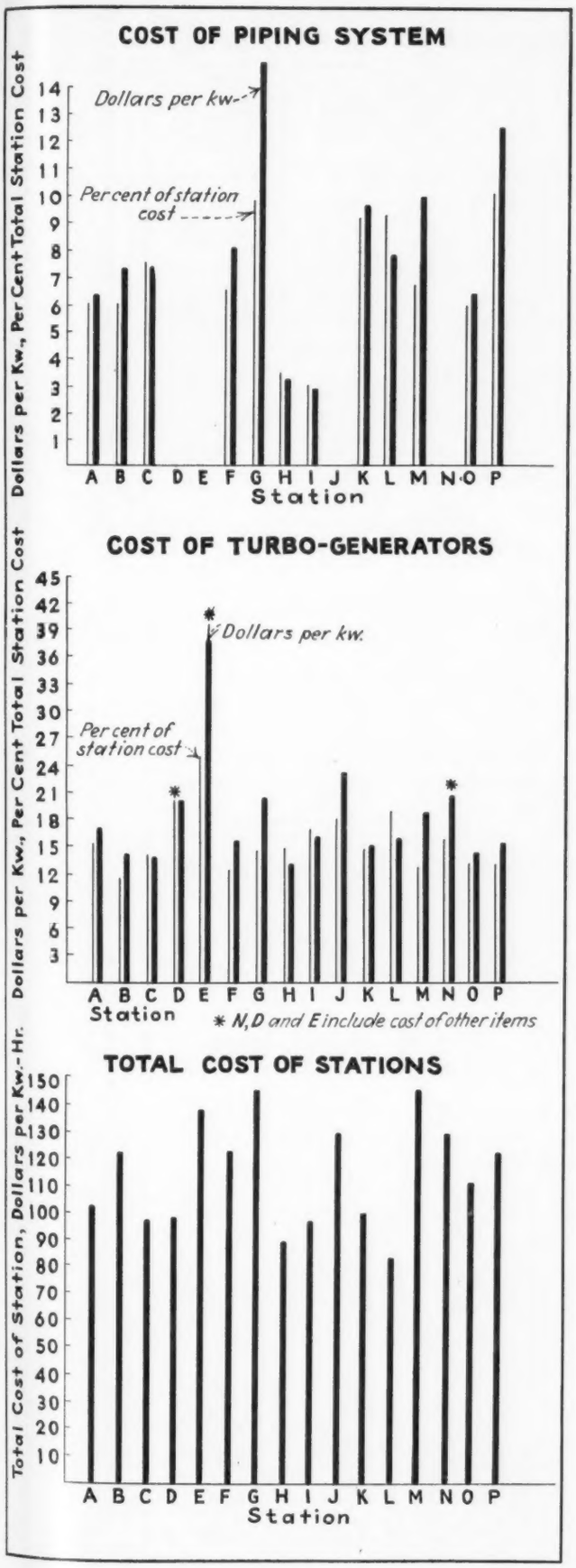
Power cost reduction must come from lower fixed charges


RELATION BETWEEN STATION SIZE AND POWER COST
Station Rating-1,000 Kw.
Total Cost of Power, Mills per Kw.-Hr.
0 20 40 60 80 100 120 140 160 180 200
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Lower unit costs for large machines may be offset by other added costs in large stations


COST OF LAND AND SITE PREPARATION
Dollars Per Kw., Per Cent Total Station Cost
Per cent of station cost
Dollars per kw.
A B C D E F G H I J K L M N O P
Station
COST OF FUEL UNLOADING, HANDLING, STORAGE
Dollars Per Kw., Per Cent Total Station Cost
Dollars per kw.
Per cent of station cost
A B C D E F G H I J K L M N O P
Station
COST OF BUILDINGS AND FOUNDATIONS
Dollars Per Kw., Per Cent Total Station Cost
Dollars per kw.
Per cent of station cost
A B C D E F G H I J K L M N O P
Station
N,J, include other items of cost
COST OF SWITCH GEAR AND STATION WIRING
Dollars Per Kw., Per Cent Total Station Cost
Dollars per kw.,
Per cent of station cost
A B C D E F G H I J K L M N O P
Station
COST OF CONDENSING WATER SUPPLY AND WORKS
Dollars Per Kw., Per Cent Total Station Cost
Dollars per kw.
Per cent of station cost
A B C D E F G H I J K L M N O P
Station
COST OF BOILER PLANT
Dollars Per Kw., Per Cent Total Station Cost
Dollars per kw
Per cent of station cost
A B C D E F G H I J K L M N O P
Station
D,E, N and J include other items of cost

Total and itemized unit investment costs for modern steam stations


COST OF PIPING SYSTEM
Dollars per kw.
Per cent of station cost
Dollars per Kw., Per Cent Total Station Cost
Station
A B C D E F G H I J K L M N O P
COST OF TURBO-GENERATORS
Dollars per kw.
Per cent of station cost
* N, D and E include cost of other items
TOTAL COST OF STATIONS
Total Cost of Station, Dollars per Kw.-Hr.

show wide variations

ticed that the range is very wide and this item is well deserving of more consideration in new designs.

Maintenance and repair costs vary in a wide range; a minimum value is 0.095 mill and a maximum 0.703 mill, with an average of 0.3 mill. It will be noted here again that size, station pressure and even load and use factors appear to have little relation to the magnitude of this cost. A figure of 0.3 mill or less seems to be a good design estimate to use for new plants. In the breakdown of the maintenance and repair costs it will be noticed that the boiler plant takes first place, with building and structures second. A reduction in this cost, therefore, must come from attention to these two major items, particularly buildings and structures.

Ranges in Investment Costs—For the complete investment cost of the station only the price range is from $82.80 to $145 per kilowatt of installed capacity with an average of $114. But the investment to deliver power to outgoing lines is assumed to cover the station and the outdoor substation also, and on this basis the unit investment ranges from $86 to $151.50, with an average of $120.

Comparison of equipment costs only

Since so many items of investment cost are controlled by the site, the cost of buildings and structures, the cost of coal handling and storage facilities and the cost of circulating water supply and works, a more logical item to discuss on a comparative basis is the total cost of equipment in the stations. The range in this cost is from $40 per kilowatt of installed capacity to $102. It will be noted that six of the stations have an equipment investment under $65 per kilowatt; five range from $65 to $75, and five exceed $75 for this investment. Stations at 1,400-lb. pressure may be found in the high and low brackets, as well as those at 400 and 600 lb.

Graphs presenting the data indicate very little relation in the cost of equipment or of complete stations to the cost of fuel, to the hours use, to the thermal efficiency obtained or to size of station.

Apparently the dollar or two saving that comes in the unit price of large turbo-generators and boilers is frequently offset by other expenditures necessitated in large and more complicated stations.

An examination of the detailed investment cost data affords interesting comparisons. For example, the unit cost of the piping system ranges from $3.16 to $15.30 per kilowatt, with an average of $8. This cost is controllable by design in large measure and is an appreciable item in total cost. The data show little relation between this cost and other station data and it seems to be dictated by individual differences in station design assembly.

Another appreciable cost item is that of switchgear and station wiring. The unit cost varies from $2.21 to $15.30 per kilowatt, with an average of $10 per kilowatt installed. The type of station and number and voltage of feeders influence this cost, but here again it appears that a good part of this cost is controllable in station design.

Great uniformity exists in the unit cost of the boiler plant and of the turbo-generators, as is to be expected. These unit costs are about equal in magnitude. Boiler plant cost ranges from $11.50 to $27.30 per kilowatt, with an average of $17. The cost of turbo-

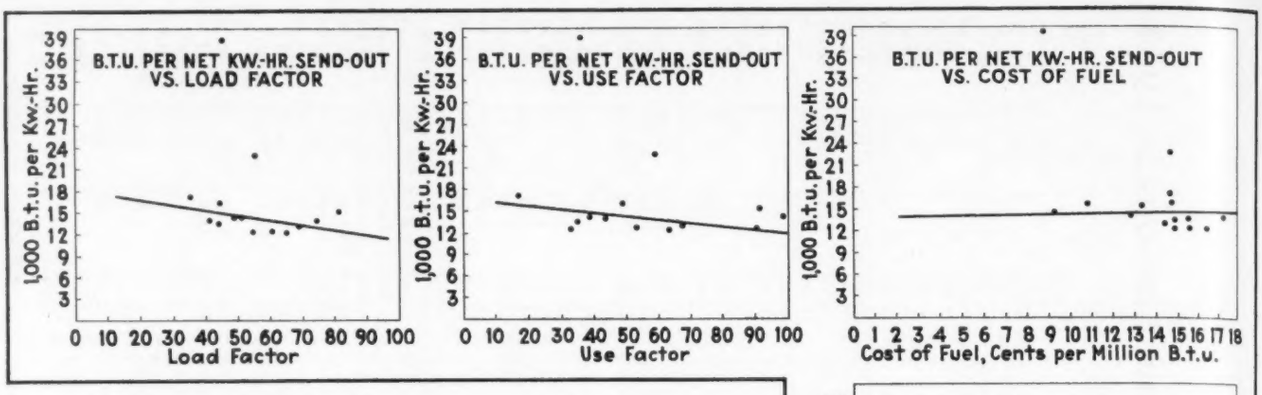
Table I—Equipment, Fuel Data and Production Costs for Steam Stations in 1934

Station	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Approximate rating, kw.	25,000+	200,000+	200,000—	50,000+	50,000+	25,000+	15,000—	50,000+	75,000+	25,000+	25,000+	25,000+	50,000+	15,000+	50,000+	125,000—
Number of generators	2	3	3	2	2	1	2	1	1	1	1	1	1	1	2	3
Number of boilers	2	6	5	3	3	2	2	2	1	2	3	2	3	3	2	4
Type of service	Trans.	Trans.	Distrib.	Trans.	Trans.	Distrib.	Distrib.	Trans.	Trans.	Trans.	Distrib.	Distrib.	Trans.	Trans.	Trans.	Trans.
Number of outgoing lines	2	10	42	6	13	8	11	2	6	3	22	6	4	4	8	10
Approx. kv. of lines	66	33–66–132	22	66	13–22–33–66	13–33	4	44–110	27–132	13–132	13	13	132	66	33–110	33–66
Fuels used in plant	Coal	Coal-Gas	Coal-Oil	Gas	Coal	Coal	Coal-Gas-Oil	Coal	Coal	Coal	Coal	Gas-Oil	Coal	Gas	Coal	Coal
Steam pressure, boiler, lb.	525	800	400	430	1,400	650	600	475	1,400	650	400	450	700	400	1,400	1,350
Steam temperature, boiler, F.	825	730	700	715	750	825	700	725	850	825	725	650	775	710	750	725
Station area, acres	0.38	3.35	2.5	0.42	0.54	0.83	0.03	0.69	0.852	16	0.2	.....	20	.....	55	70
Fuel storage area, acres	0.75	7.2	7.65	3 tanks	5.0	1.24	.....	.....	7.66	in above	1.5	.....	1.6	0.34	.....	.....
Size of boilers	19,800 sq.ft.	450,000 lb	28,500 sq.ft.	17,900 sq.ft.	300,000 lb.	375,000 lb	10,500 sq.ft.	30,000 sq.ft.	700,000 lb.	300,000 lb.	18,600 sq.ft.	22,500 sq.ft.	345,000 lb.	10,000 sq.ft.	250,000 lb	9,000 sq.ft.
Ave. cooling water temp.	61	54	50	75	55	61	70	.....	.....	37	63	60	52	63	54	58
Ave. vacuum on condensers	28.74 Hg	0.44 lb.	28.7 Hg.	1.19 in.	29.05 Hg.	1.06 in.	27.13 Hg.	.....	.....	28.86 Hg.	1.54 in.	28.5 Hg.	1.03 in.	28.42 Hg.	29.00 Hg.	1.3 in.
Number in operating force, shift	5	61	47	7	11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Equipment Used																
Air preheating	√	√	√	√	√	√	√	√	√	√					√	√
Steam reheating		√			√				√						√	√
Economizers	√	√	√		√	√	√			√	√				√	√
Waterwall furnaces	√	√	√	√	√	√	√	√	√	√	√	√			√	√
Stokers			√				√				√					
Stage bleeding	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√
Duplicate feed pumps	√	√	√	√	√	√	√	√	√	√	√	√			√	√
Generator air coolers	√	√	√	√	√	√	√	√	√	√	√	√			√	√
Automatic combustion		√	√	Not in use	Semi-	√		√	√		√	√			√	√
Outdoor switchyard	√	√		√	√	√		√	√	√		√	√	√	√	√
Fuel Data for 1934																
Total fuel used																
Short tons of coal	42,027	395,282	283,023	.....	67,065	84,891	11,737	15,670	Not operated in 1934	58,183	84,065	.....	174,281	.....	138,687	482,828
1,000 cu.ft. of gas	.....	7,763,800	.....	.....	.....	.....	1,146,000	.....	.....	.....	.....	318,770	.....	.....	.....	.....
Barrels of oil	275.5	.....	5,479	1,475,000	.....	.....	25	.....	.....	.....	.....	2,118	.....	1,814,957M	.....	.....
Ash content of coal, per cent	4.18	12.59	7.4	.....	9.2	6.25	14.70	13	.....	4.16	4.96	.....	10.8	.....	7.33	5.7
Moisture content, per cent	2.89	13.24	4.32	.....	2.3	2.70	6.40	6	.....	5.94	3.21	.....	11.8	.....	3.73	4.5
Fuel Cost Delivered, dollars																
Per short ton of coal	4.23	3.44	3.49	.....	4.21	4.26	3.53	2.63	.....	4.16	4.23	.....	3.56	.....	4.60	3.80
Per 1,000 cu.ft. gas	.....	0.125 mil.B.t.u.	.....	0.155	.....	.....	0.1495	.....	.....	.....	.....	0.11	.....	0.0965	.....	.....
Per bbl. of oil	2.56	.....	2.05	1.02	.....	.....	1.36	.....	.....	.....	.....	0.87	.....	.....	.....	.....
Heat Value of Fuel as Fired																
Coal, B.t.u. per lb.	14,302	10,433	13,370	.....	13,560	14,305	11,680	12,000	.....	13,215	14,318	.....	11,100	.....	13,893	14,016
Gas, per cu.ft.	.....	1,038	.....	1,050	.....	.....	1,029	.....	.....	.....	.....	1,200	.....	1,037	.....	.....
Operating Costs, 1934 (mills per net kw.-hr.)																
Fuel	2.057	1.945	1.868	2.59	2.11	1.896	2.86	Operated	.....	2.467	Not segregated, an extension	3.50	2.088	1.35	2.04	2.09
Wages and superintendence	0.512	0.207	0.862	0.73	0.531	0.311	0.55	only 1 mo.	.....	0.469		0.20	0.463	0.19	0.24	0.26
Water, lubrication and supplies	0.092	0.022	0.139	0.013	0.127	0.042	0.24	in 1934	.....	0.031		3.8	0.042	.04	0.03	0.03
Maintenance and repairs, total	0.306	0.152	0.401	0.317	0.703	0.108	0.42	.....	.....	0.095	.....	0.6	0.208	0.12	0.26	0.24
Buildings and structures	0.016	0.009	0.051	0.083	0.143	0.002	0.06	.....	.....	.....	.....	.....	0.0175	.....	.....	0.04
Boiler plant	0.236	0.115	0.174	0.143	0.343	0.057	0.25	.....	.....	.....	.....	.....	0.127	.....	.....	0.15
Fuel-handling equip	.....	0.005	0.025	.....	.....	0.033	.....	.....	.....	.....	.....	.....	0.004	.....	.....	.....
Prime movers and aux.	0.054	0.023	0.067	0.061	0.216	0.016	0.10	.....	.....	.....	.....	.....	0.053	.....	.....	0.05
Elect. equip. and miscel.	.....	.....	0.084	0.03	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total operating and maintenance	0.910	0.609	1.402	1.06	1.362	0.461	1.21	.....	.....	0.595	.....	7.50	0.713	0.314	0.538	0.53
Total production cost (no fixed charges)	2.967	2.554	3.272	3.65	3.473	2.357	4.07	.....	.....	3.062	.....	8.10	2.79	1.70	2.55	2.62
Total gross generation, millions kw.-hr.	91.6	1,278.02	555.04	93.42	157.60	202.27	69.88	26.44	.....	118.12	152.70	14.21	310.08	133.80	334.75	948.73
Total net generation, millions kw.-hr.	86.7	1,217.65	531.56	90.85	142.42	191.	62.12	24.53	.....	110.85	145.14	9.99	291.23	129.82	312.73	878.04
Max. load, kw., 30-min. peak	22,500	200,000	125,000	30,000	26,500	40,000	15,000	60,000	.....	30,700	40,000	25,000	72,000	20,000	57,000	133,000

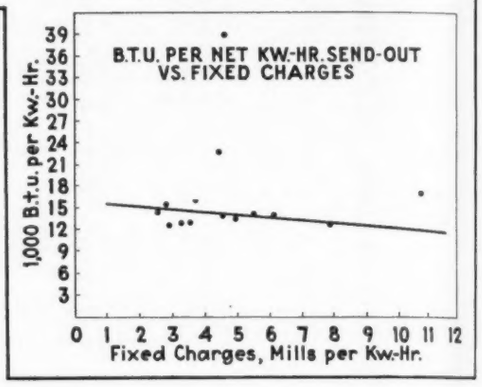
A, normal transmission station; B, superpower type of transmission station; C, normal distribution station; D, normal transmission station; E, normal combination transmission and distribution station; F, normal system station; G, normal distribution station; H, standby type on hydro system; I, normal new station not operated 1934; J, normal transmission and distribution station; K, normal distribution station; L, standby type on hydro system; M, normal transmission station; N, normal transmission station used on base load; O, normal transmission station; P, combination power and process steam for which credit is not given in data; if corrected for this the thermal performance for power generation is reduced to about 11,800 B.t.u. per kw.-hr. and there would be an appreciable reduction in investment and operating costs.

Table II—Unit Investment Cost, Total Power Cost and Performance of Steam Stations in 1934

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Unit Investment Cost, Dollars per Kw.																
Land, cost and site preparation	0.88	6.30	6.12	7.87	1.95	13.01	2.33	1.82	4.59	5.67	3.46	3.07	15.30	11.90	1.24	12.38
Buildings and foundations	15.74	26.70	26.70	27.20	23.50	23.50	22.70	23.30	20.88	39.16	23.30	20.60	44.80	40.20	20.50	17.80
Condensing water supply and works	3.66	3.24	2.02	.....	.....	4.73	8.43	7.88	1.75	.....	3.14	3.13	3.39	.....	1.90	3.50
Fuel unloading, handling, storage	0.84	6.75	4.46	.....	.....	3.31	4.75	1.28	14.91	.....	4.44	1.83	3.93	.....	3.37	7.20
Ash handling	0.74	1.40	.....	.....	.....	1.72	4.02	0.38	0.72	.....	3.57	.....	0.44	.....	0.59	0.56
Fuel preparation	3.19	3.70	4.40	.....	.....	2.28	.....	2.25	3.32	.....	0.09	.....	3.92	.....	2.78	4.63
Switchgear and station wiring	7.54	20.30	2.21	5.82	.....	15.32	15.30	8.66	7.74	.....	14.10	6.15	14.50	13.00	7.44	7.97
Boiler plant	17.54	16.90	14.95	29.30	58.87	13.60	27.30	15.55	12.67	47.75	14.75	11.50	20.00	38.50	17.80	23.20
Draft system	3.26	3.57	1.05	.....	.....	9.77	3.29	3.84	1.42	.....	2.07	2.06	1.08	.....	2.49	5.91
Feedwater system	3.07	1.38	0.81	.....	.....	4.32	3.67	3.23	2.88	.....	2.26	1.73	1.53	.....	2.54	2.95
Piping system	6.40	7.28	7.34	.....	.....	8.08	15.30	3.16	2.90	.....	9.60	7.80	10.00	.....	6.33	12.50
Turbine foundations	0.84	0.15	1.32	.....	.....	0.45	1.07	0.58	0.89	.....	0.94	1.21	0.58	.....	.....	0.61
Heat recovery apparatus	.....	.....	1.73	4.83	.....	.....	4.84	1.08	1.72	.....	.....	.....	4.85	.....	1.13	1.66
Generator air coolers	.....	0.34	0.15	.....	.....	0.28	0.63	0.19	0.23	.....	0.19	0.25	.....	.....	.....	0.55
Main condensers	3.77	2.67	2.60	.....	.....	1.78	5.38	2.81	2.60	12.05	3.70	3.61	1.88	.....	2.86	3.13
Turbo-generators	16.33	14.25	14.15	21.20	36.50	15.30	20.03	13.12	16.33	23.23	15.15	15.70	18.65	20.00	13.10	16.60
Turbine auxiliaries	.....	0.32	4.68	.....	.....	0.44	6.57	0.54	0.50	1.47	2.78	2.00	1.41	.....	.....	.....
Outdoor switchyard	10.99	7.50	1.21	10.40	13.40	2.79	.....	5.74	5.21	6.11	.....	3.70	1.93	1.23	3.98	14.00
Total station	103.53	120.80	96.70	97.60	138.20	121.50	145.50	89.70	96.05	129.50	102.50	82.80	145.00	129.50	106.00	122.50
Total station and switchyard	116.18	127.50	97.80	107.80	151.50	124.50	145.50	95.50	101.26	135.50	102.50	86.00	147.50	142.00	110.00	137.00
Cost of Power, mills per net kw.-hr.																
Fixed charges at 15 per cent	6.02	3.27	4.42	10.72	7.98	3.43	4.24	.....	.....	5.52	3.73	4.51	4.94	2.47	2.91	2.77
Production charges	2.97	2.55	3.27	3.65	3.47	2.36	4.07	.....	.....	3.06	.....	8.10	2.79	1.70	2.55	2.62
Total cost of power per kw.-hr	8.99	5.82	7.69	14.35	11.45	5.79	8.31	.....	.....	8.58	.....	12.61	7.73	4.17	5.46	5.39
Fixed charges at 75 use factor	2.61	3.55	2.23	2.52	3.28	2.57	3.23	.....	.....	2.51	.....	1.83	3.41	3.28	3.60	2.95
Production charges at 50 load factor	2.77	2.93	3.17	2.80	4.76	2.71	3.37	.....	.....	3.29	.....	7.30	2.73	2.54	3.31	4.24
Total equivalent cost of power	5.38	6.48	5.40	5.32	8.04	5.28	7.60	.....	.....	5.80	.....	9.13	6.14	5.82	6.91	7.19
Total equiv. cost—75 U.F., 50 L.F. and 15c. fuel cost	5.08	6.85	5.70	5.02	7.47	5.14	6.43	.....	.....	4.74	.....	11.48	5.77	7.08	6.70	7.58
Station Performance in 1934																
Millions B.t.u. used	1,202,090	16,355,640	7,651,600	1,551,000	1,820,000	2,422,000	1,454,000	377,000	.....	1,568,000	2,410,000	396,820	3,980,000	1,885,000	3,860,000	13,520,000
Fuel cost, cents per million B.t.u.	14.80	14.45	12.90	14.75	15.50	14.85	14.65	10.90	.....	17.45	14.75	8.85	15.55	9.26	16.50	13.45
B.t.u. per net kw.-hr. send-out	13,873	13,392	14,240	17,435	12,772	12,765	23,100	15,350	.....	14,153	16,580	39,700	13,350	14,498	12,305	15,400
B.t.u. per gross kw.-hr. generated	13,120	12,830	13,820	16,700	11,600	12,050	20,100	14,250	.....	13,220	15,750	22,800	12,800	14,100	11,500	14,250
Ave. boiler efficiency, per cent	87.9	.....	84.6	78.74	85.76	84.30	79.50	82.50	.....	87.74	77.60	.....	86.30	83.60	85.40	87.58
Thermal efficiency, net basis	24.5	25.4	23.8	20.00	26.70	26.90	14.50	22.20	.....	24.10	20.50	8.60	25.00	23.40	30.50	22.05
Employees per 1,000 kw. per day	1.3	0.88	1.75	0.35	0.86	0.60	1.20	.....	.....	0.60	1.50	0.60	0.37	0.60	1.30	1.16
Load factor, annual, per cent	43.0	69.50	48.50	34.50	61.60	54.10	53.20	.....	.....	41.00	43.70	45.50	48.90	75.00	65.00	81
Use factor, annual, per cent	34.9	67.20	38.00	17.80	32.50	62.50	59.30	.....	.....	42.00	49.30	36.00	51.90	99.30	92.50	91
Station Unit Space Factors																
Boiler room, cu.ft. per kw	23.50	20.80	17.70	11.13	29.50	43.60	41.50	18.70	15.20	23.50	22.30	31.70	30.70	21.90	17.30	22.40
Turbine room, cu.ft. per kw	13.40	12.90	15.00	13.80	11.15	27.60	30.00	7.95	8.85	19.65	10.70	19.00	26.50	11.00	10.40	17.90
Switchhouse, cu.ft. per kw	0	20.00	9.38	0.19	4.95	15.60	17.00	2.19	1.03	2.67	5.60	2.36	3.00	2.00	5.28	2.59
Fuel preparation room, cu.ft. per kw	0	0	3.64	0	1.71	0	.....	4.06	.....	.....	7.00	.....	.....	.....	3.50	4.80
Station site, sq.ft. per kw	0.55	0.70	0.68	0.30	0.47	1.03	1.35	0.50	0.46	0.83	0.25	0.40	1.07	0.88	0.39	0.63
Storage site, sq.ft. per kw	1.09	1.51	2.08	.....	4.33	1.54	.....	.....	4.17	.....	1.87	.....	13.40	.....	43.70	.....
Switchyard, sq.ft. per kw	2.06	2.72	0	1.02	2.50	.....	.....	0.34	0.52	1.07	.....	0.18	2.55	1.49	6.34	2.69
Storage capacity, tons per kw	0.20	0.29	0.75	.....	0.50	0.28	0.18	.....	4.10	0.16	0.63	.....	0.15	.....	0.13	0.84


B.T.U. PER NET KW-HR. SEND-OUT VS. LOAD FACTOR
1,000 B.t.u. per Kw.-Hr.
Load Factor
B.T.U. PER NET KW-HR. SEND-OUT VS. USE FACTOR
Use Factor
B.T.U. PER NET KW-HR. SEND-OUT VS. COST OF FUEL
Cost of Fuel, Cents per Million B.t.u.

Relation of thermal performance of modern steam stations to design factors



generators ranges from $13 to $20 per kilowatt, with an average of $16. Neither cost bears any evident relation to other station design factors, such as size, pressure or use factor, and at least a part of this cost is controllable in station design.

A study of the cost of buildings and structures should be accompanied by a study of the data on unit space factors. This unit cost exceeds that of the boiler plant or of the turbo-generators on an average and a large part of this cost is controllable by designers. A reduction in the unit space factors, however, must be measured against safety and operating convenience. Nevertheless, the compact unit station assembly idea, if applied, makes for a minimum structure cost. Another element to consider is to get a type of structure that permits the station to be remodeled at a minimum cost.

Conclusion

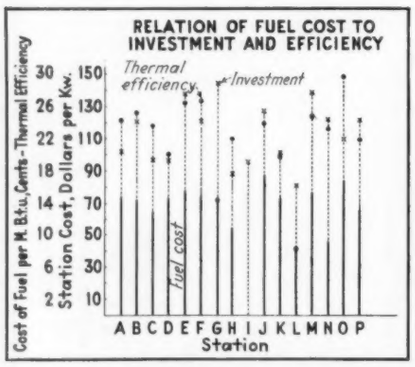
Engineers have made remarkable improvements in steam station design and equipment and the thermal performance of this group of plants shows this fact. The marked reduction in the use of fuel has saved money and aids conservation. In the future, however, it is doubtful if a marked increase in thermal performance will be had in the steam cycles and cost reductions must be looked for in terms of a reduction in investment charges.

Since much of the new capacity needed in the industry will come from remodeling old stations, it is encouraging to note the economy of the high-pressure, high-temperature plants already built, for the superposition of a high-pressure unit is a first and logical approach to remodeling. Incidentally, on new stations a combination of a high-pressure, high-temperature unit to carry base load and an intermediate pressure installation to carry the other load may make for an economical combination. The full use of reserves and the desirability of flexibility must be considered.

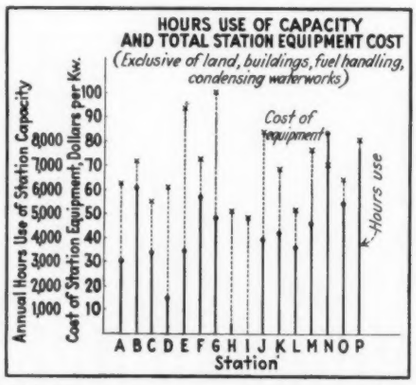
In the analysis of the data some general conclusions are made on the basis of these specific plants and of a similar group of plants for which data were published in 1927. These deductions do not apply to the entire industry and each has exceptions when used to discuss power stations for particular locations and applications. Also, the use of arithmetical averages and unit values should be based upon the same limited considerations, with the further stipulation that they serve merely as indicators to experienced power station engineers and operators rather than finite values from which to generalize.

This study is representative of only a limited cross-section of the total power production in the country and is presented in the hope that it may serve as check guides for building new stations and remodeling old stations. There has been a rapid development in the art and in equipment and these data guides can be used to best advantage only when a complete knowledge of these new developments is available.

These data on modern power plants give evidence that the new capacity now needed by the industry should be installed with a full consideration of the economics of power generation and a complete knowledge of the new developments in the art and in equipment. Costs will be reduced in the new plants. It should be noted, however, that the cost of power as shown by these plants merely indicates cost values for representative modern plants and the data or averages do not apply to deductions on power cost for the industry as a whole.


RELATION OF FUEL COST TO INVESTMENT AND EFFICIENCY
Thermal efficiency
Investment
Fuel cost
Cost of Fuel per M. B.t.u., Cents - Thermal Efficiency
Station Cost, Dollars per Kw.
Station

Economic relations of investment, fuel cost and performance

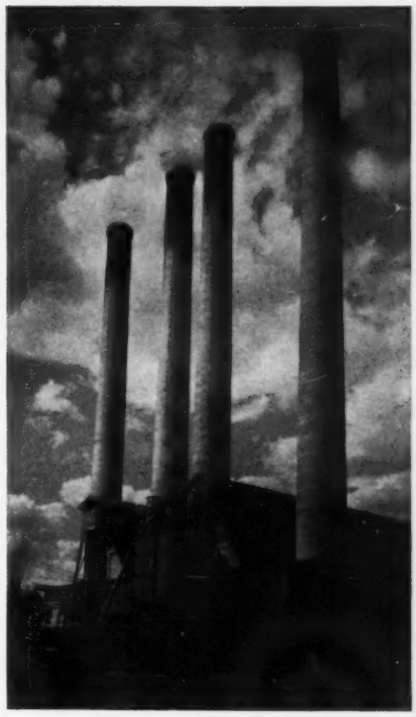

HOURS USE OF CAPACITY AND TOTAL STATION EQUIPMENT COST
(Exclusive of land, buildings, fuel handling, condensing waterworks)
Cost of equipment
Hours use
Annual Hours Use of Station Capacity
Cost of Station Equipment, Dollars per Kw.
Station

Equipment cost varies widely and has little apparent relation to use factor

Superimposed Unit at Cedar Rapids

New 700-Lb. Boiler Feeds 210-Lb. Header Through a Non-Condensing Turbine—Water-cooled Underfeed Stokers Used

By W. H. PROESCHOLDT
Iowa Electric Light & Power Company



IN ITS Cedar Rapids power station the Iowa Electric Light & Power Company will soon place in operation a new steam generator capable of making steam at the rate of 300,000 lb. per hour at 700 lb. per square inch gage pressure and 765 deg. F. total temperature. Steam from the high-pressure boiler will pass through a non-condensing turbine which will exhaust directly into the present 210-lb. station header. This header supplies steam to five condensing turbo-generators and to one 6,000-kw. non-condensing turbine, which in turn exhausts steam for the city heat system and to the Quaker Oats Company for process use. The fuel cost resulting from superimposing the high-pressure unit on the entire plant will be about 11,200 B.t.u. per gross kilowatt-hour.

Two low-pressure (210-lb.) boilers, which had a total steaming capacity of 50,000 lb. per hour, were removed to provide space for the new unit, which can generate steam at the rate of 300,000 lb. per hour, or an increase of six times in steaming capacity for the same floor space.

The new boiler and furnace are being built by the Springfield Boiler Company. This boiler will be of the cross-drum, straight-tube type. An interdeck "Elesco" superheater will heat the steam to the required degree. The slope of the tubes in the lower boiler bank is at 15 deg. from horizontal, while the slope of the tubes in the upper bank is at 25 deg. This was done to promote tube removal and provide better circulation within the upper rows of boiler tubes. A slag screen 17 in. deep is provided, with provisions made to increase its depth to 27 in.

The furnace is completely water-cooled on all sides by a wall composed of 3-in. bare tubes placed on $3\frac{9}{16}$-in. centers. Through the center of the furnace a double water wall extends from below the stoker to within the superheater zone. This double wall is composed of 3-in. bare tubes on $3\frac{9}{16}$-in. centers placed back to back.

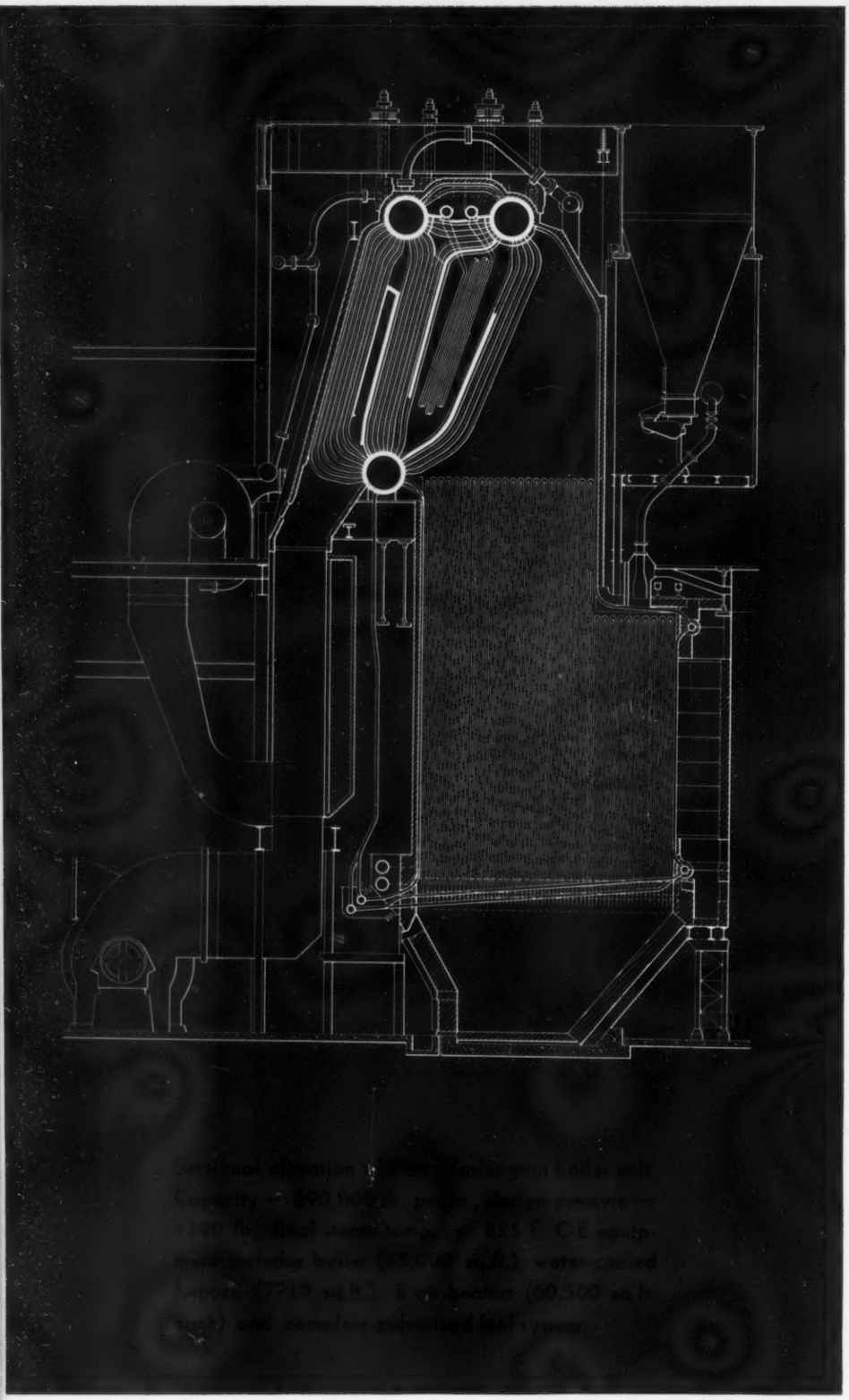
Coal from Atkinson, Ill., will be burned in the furnace, the ash from which melts at about 1,900 deg. F. This characteristic has been a determining factor in the design of the stoker, furnace, boiler and superheater.

Strange as it may seem, a stoker was selected to burn a fuel with so low an ash fushion temperature. The stoker selected is being made by the American Engineering Company and will be a water-cooled, underfeed type. Considerable experimenting has been done in the Cedar Rapids power station during the last two years on water-cooling underfeed stokers. At the present time eight underfeed stokers are water cooled, most of which are approximately ten years old. Prior to water cooling the tuyères it was impossible to keep a boiler on the line for more than an hour at normal load when burning low fusion ash coal. We have successfully burned this coal at the rate of 55 lb. per square foot of stoker area (air admission part only) with no ill effect on the stoker, the limiting factors being sufficient air- and steam-relieving capacity of these old units. When tuyères are water cooled the effect is to freeze the molten ash quite some distance up in the fuel bed. This allows unrestricted flow of air and proper functioning of the stoker. Because of the experience gained in water cooling the old stokers in the station a water-cooled stoker was chosen for use under the new boiler.

Many existing stations can be remodeled to increase their capacity and efficiency. Each case requires individual analysis, but in general the higher increment cost for the added capacity is more than offset by the effect on improving the performance of the old equipment. This article gives a current example of an interesting case of remodeling by use of a high-pressure boiler installation and a non-condensing turbo-generator.

The turbine was purchased from the General Electric Company and will exhaust into the present 210-lb. header. It is the intent in the design of the superheater and turbine to give virtually a constant superheat in the exhaust steam as it enters the 210-lb. header.

700,000-lb C-E



OTHER NOTABLE C-E INSTALLATIONS IN UTILITY PLANTS

Highest Capacity Boilers

Three C-E Multi-Drum Boilers at East River Station, New York Edison Co. Have operated at rate of 1,270,000 lb. of steam per hr. per unit.

Highest Capacity Stoker-Fired Boilers

Eight C-E Multi-Drum Boilers at Hudson Avenue Station, Brooklyn Edison Co. Capacity per boiler — 530,000 lb. per hr. Hudson Avenue is the world's largest power station.

Highest Capacity Single Sectional Header Boiler

C-E Sectional Header Boiler at Burlington Station, Public Service Electric & Gas Co. of N. J. Has operated at rate of 625,000 lb. per hr.

Boiler Holding Record for Highest Sustained Output

C-E Multi-Drum Boiler at Kips Bay Station, New York Steam Corp. Has averaged 805,000 lb. per hr. for a month. The five steam generating units in Kips Bay, the largest central heating plant in the world, are comprised of C-E equipment.

Largest Single-Pass Sectional Header Boiler

C-E Sectional Header Boiler at Duluth Station, Minnesota Power & Light Co. Boiler is 40 tubes high by 38 tubes wide and has 36,550 sq.ft. of heating surface.

Largest Modernization Project Now Under Way

Six C-E Multi-Drum Boilers — two purchased in 1932, two in 1934 and two in 1935 — for Conners Creek Station, Detroit Edison Company. Capacity — 330,000 lb. each, pressure —710 lb. gage, final steam temperature—850 F. These six units will triple capacity of boilers they replace.

COMBUSTION

Steam Generating Unit

sole source of steam supply for Newest Central Station

Port Washington, the newest central station in the country and one of the most modern in the world, was recently placed in service by The Milwaukee Electric Railway & Light Company with a C-E Steam Generating Unit as the sole source of steam supply for an 80,000 kw. turbine-generator. Thus for the first time in large station practice the reliability and availability of present-day boiler and furnace equipment are given recognition as being at least equivalent to that of turbine-room equipment. The Milwaukee Company's experience with high pressure boiler units at its Lakeside Station provided ample justification for the decision to install one boiler per turbine. There three 1390-lb. C-E Boilers have had an average availability of 96.3% over a 4-yr. period.

The Port Washington boiler unit is notable in many respects. Capable of producing approximately 700,000 lb. of steam per hr., it is the largest 3-drum bent tube boiler built to date and is the highest-capacity single-set boiler of any type. It is also the highest capacity, super-pressure (1390 lb.) boiler thus far installed in a central station. Its forged steel drums are over 60 ft. long and have a shell thickness of 5¼ in. They are the largest and heaviest boiler drums ever built, weighing about 70 tons each. The height of the unit from the bottom of the furnace to the top of the boiler is equivalent to that of an eight-story building, and its width is about that of a six-lane highway.

This great boiler unit is an important addition to Combustion Engineering's record of service to the central station industry — a record which includes such outstanding installations as those listed on the opposite page.

C-E experience in connection with utility plant projects — new plants or modernization or extension of existing plants — can contribute materially to the successful development and completion of such projects. Since C-E equipment — boilers, furnace, fuel burning and related equipment — is complete for units from less than 100 hp. up to the largest, the size of the project is not a factor.

COMBUSTION ENGINEERING COMPANY, INC.
200 MADISON AVENUE NEW YORK, N. Y.
Canadian Associates, Combustion Engineering Corp., Ltd., Montreal

ENGINEERING

A-25

Additions to Steam Plant Capacity

[*Continued from page 23*]

stokers has been applied to several stoker installations with reported satisfactory results in control of fuel bed and improvement in efficiency of combustion.

The unit system of pulverized coal firing is now used in a large majority of installations. Capacity of unit mills has been increased, permitting the use of a reasonable number of mills with the largest steam generating units. Improved design and construction with better classification have resulted in attaining and maintaining a greater degree of fineness and decreasing maintenance costs. Noise, formerly a decidedly objectionable feature in most mills, has been reduced to a satisfactory degree. Proper regulation proportions the amount of primary air to the rate of grinding in unit mills and eliminates or greatly decreases difficulties in maintaining ignition at light loads. Although of limited application, a type of anthracite coal burner recently installed in an industrial plant has shown remarkable results in igniting and maintaining ignition of this rather difficult fuel.

Dust eliminators are now in common use both with pulverized coal and stoker firing. The electrostatic type, heretofore used only with the former method, has been installed in a stoker-fired plant with reported satisfaction. A vertical passage type has been developed and changes in interior design and construction have decreased both weight and cost of this equipment. Improvements have been made in the wet-type eliminator and new applications of the centrifugal type have been developed. Some fan manufacturers are using the principle in combination with their equipment.

Hydraulic coupling, largely used in Europe, and more recently introduced into this country, has been used in a few plants. In addition to fans, its application has been extended to boiler feed pumps. Thrust bearings, a source of trouble in earlier couplings, are made more rugged and speed of response to load changes has been quickened by the substitution of a pump for oil supply and removal instead of the original scoop and weir. The "Thyratron" motor, advocated for several years for auxiliary drive by one manufacturer, has been developed to a point where one company is contemplating a trial installation. It has not, however, been subjected to the exacting requirements of power station operation.

Heat balance is now, as always, a problem for the engineer in his quest for the ultimate B.t.u. Solutions are myriad, and while the element of investment cost may seem small, it appears that *some attempt should be made toward a degree of standardization for different pressure conditions and unit sizes.* As regards equipment, there have been several installations of direct contact heaters recently made. These have all experienced difficulties, which, however, have been ironed out after several months' operation. Use of these heaters in one instance of which the author has personal knowledge resulted in slightly less investment cost and a small increase in efficiency.

Quest for ultimate B.t.u.

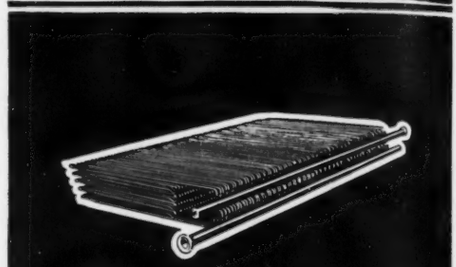
Use of automatic control is growing and the equipment is being made more rugged and reliable. Modern plants have the means for adjustment of such controls brought to one central point at which are located also the various indicating and recording instruments. This centralization of control greatly facilitates observation and checking plant operation with a minimum of personnel.

Pressures higher than 1,400 lb. and the varying of these pressures in accordance with the load on the turbine unit, up to a maximum of about 3,000 lb., are being studied intensively with a view to obtaining high efficiency through a wide load range.

The mercury vapor turbine is in commercial operation in three stations, the oldest installation having been made about ten years ago. It has demonstrated its efficiency, and while operating troubles have been encountered, these are being studied with promise of solution. The determination of the manufacturers to push this development keeps it within the realm of possibilities for further economies, particularly in the field of superposition.

The author has attempted to discuss some of the fundamental ideas which appear to him as affecting the immediate future of power supply. The problem is one requiring the combined efforts of both operating and designing engineers, be the latter a part of the company's own forces or an independent consultant.

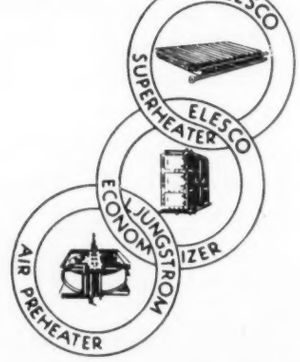
Profit in



STEAM

Elesco superheaters increase power plant efficiency more per unit of investment than any other single factor in steam engineering today.

Elescoordinated basic principles are identified with maximum profit in steam.



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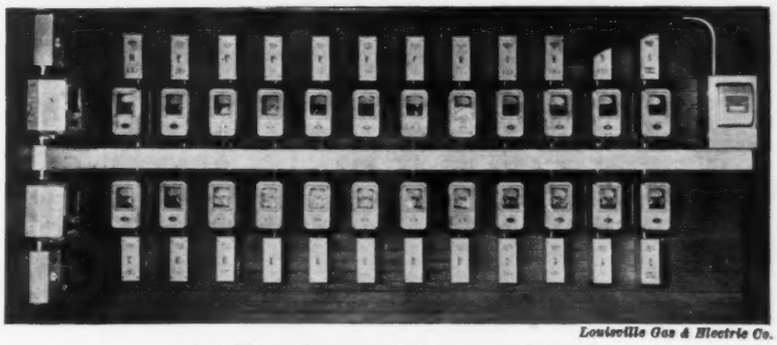
Condenser Tube Troubles Reduced

Condenser tube corrosion at the plant of the Lynn Gas & Electric Company has been reduced considerably during the past few years by attention to cleaning and air removal, according to James A. Cook, general manager of this utility. The upper half of a 22,000-sq.ft. condenser which went into service in 1929 was retubed in 1930. This is a two-pass outfit with divided water boxes. It contains a total of 4,144 1-in. outside diameter No. 18 B.W.G. tubes 20 ft. 2½ in. long. In normal operation with two pumps in service 63,000 gal. of water is circulated per minute, and the average water velocity through the tubes is 6.4 ft. per second. Mr. Cook stated that the largest factor in prolonging condenser tube life has been the scheduled annual cleaning of the circulating tunnel and semi-annual cleaning of the screen wells.

When improving the conditions in this condenser plant, a vent pipe was placed over the intake well to release entrained air. The next remedy was to drill seven 1-in. holes in the crown of each half of the division plate above the inlet water boxes, allowing a small amount of water to bypass the condenser completely. In this way at least a portion of the entrained air bubbles go through these openings. Air take-off pipes were installed at the top of each inlet water box and extended to the high vacuum point of the circulating water as it left the condenser outlet water boxes. Dams were installed in the condenser circulating water discharge pipes to keep the condenser full of water even with the circulating pumps out of service and to prevent any water-line attack.

At the time the first pass tubes were renewed with Admiralty tubes, 30 "Yorcalbro" tubes were installed at the top of the section, where they were exposed to severe corrosion. Since then three other kinds of tubes have been installed, as well as Admiralty tubes of another make, to determine if a more suitable material for local conditions could be found. The water boxes were painted carefully with two coats of "Apexior" paint (cold and

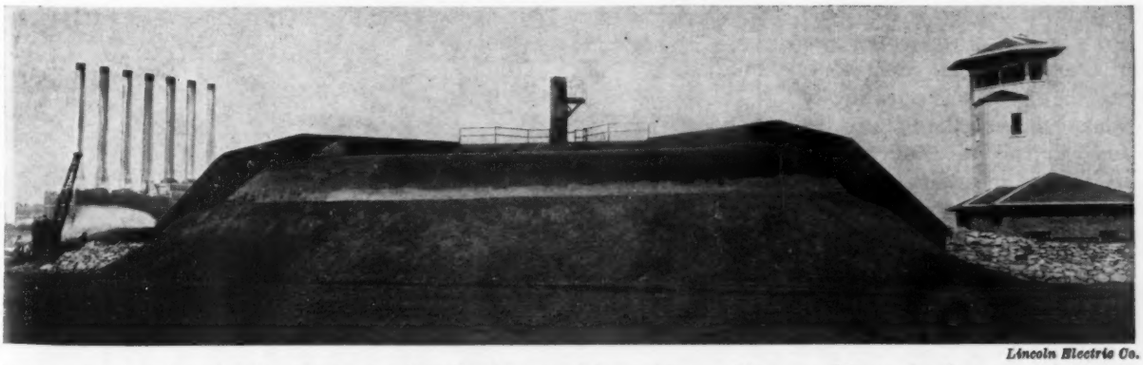


Louisville Gas & Electric Co.

A Modern Meter Job

Circuit breakers for overload protection, new sequence meter locations, complete meter inclosures and raceway bus wiring are modern features of this multiple-meter installation completed recently in a Louisville, Ky., apartment building by the Childers Electric Company of that city. The owner of the building was so pleased with the appearance and performance of this 26-meter installation that he had three other apartment houses similarly rewired for a total of 73 meters.

Arc-Welded Drag-Line Ramp



Lincoln Electric Co.

It is impossible for the lip of the drag-line bucket to stub against a rivet on this car-loader ramp because there are no rivets there. The ramp is of steel plate, arc welded. This dragline car loader is used to take coal out of reserve storage for the power plant at the left in the picture.

wet) after being cleaned with wire brushes. Up to the present time experience has indicated only that the "Yorcalbro" tubes installed have shown the least corrosion. It has been decided to clean out the mussels from the intake tunnel at least yearly; to clean the condenser regularly with rubber plugs, and oftener if the inlet tube sheets become plugged; to keep the air removal equipment sound and clear, and to paint the water boxes every year with "Apexior."

•

Standard Manholes in Detroit

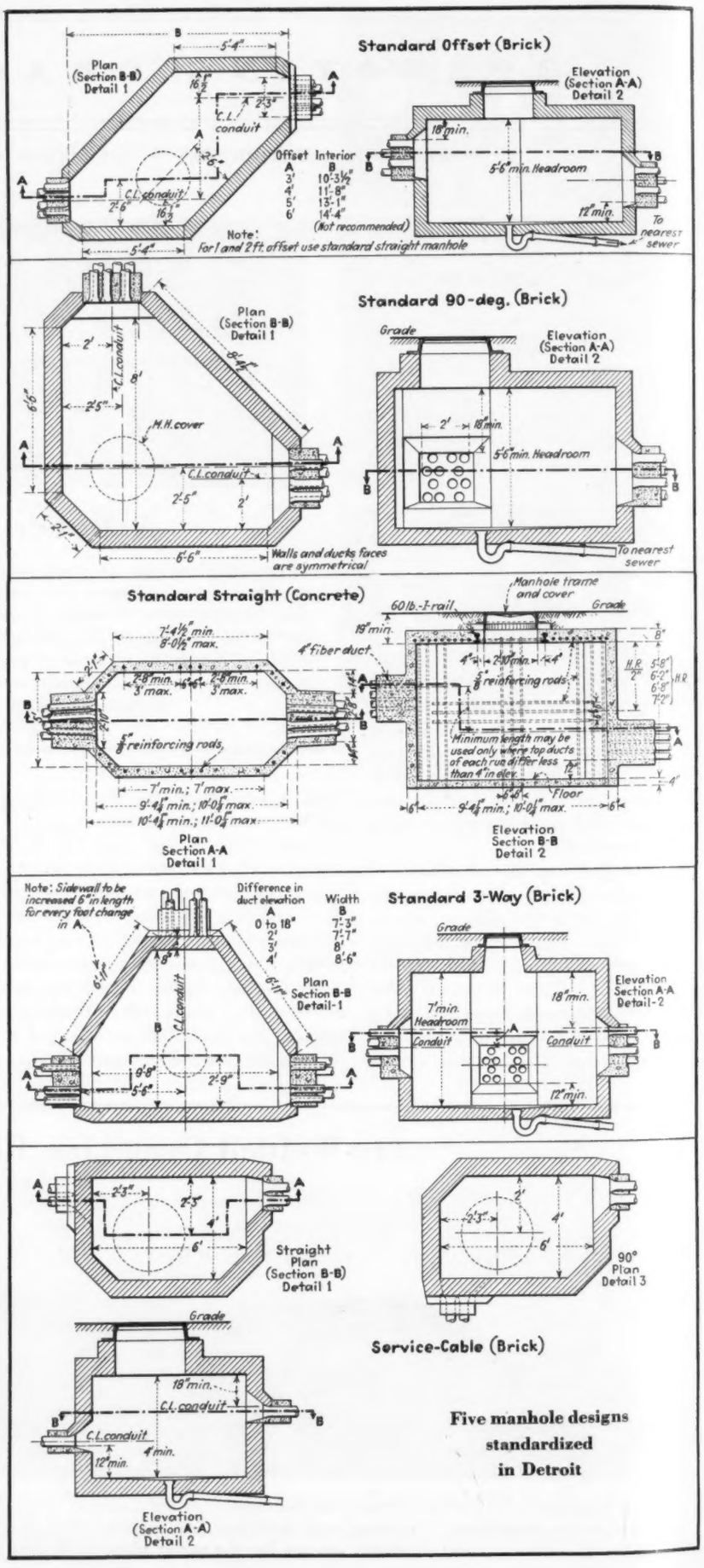
In spite of all obstructions, it is possible to have standard designs for manholes that can be followed in the majority of cases and call for only slight deviations in individual cases. The accompanying illustrations show some of the standards used by the Detroit Edison Company. The lowest duct in the lowest conduit is kept not less than 1 ft. above the finished floor. The clear headroom from floor to ceiling is not less than 5 ft., except in the cases of manholes for service cables or street lighting, for which a headroom of 4 ft. is considered sufficient. Another determining feature of manhole height is the requirement that the highest duct should be not less than 18 in. below the ceiling. Drainage requirements will sometimes determine the depths of manholes.

•

Manhole Switch-Tank Pressure Test

By C. L. ABBOTT
Underground Department,
Nebraska Power Company, Omaha

When installing manhole oil switches we drill and tap a $\frac{3}{8}$-in. hole in the cover and another in the case at the oil level. After all connections are made the switch is completely filled with oil through the hole in the cover and air pressure of several pounds is applied by means of an ordinary automobile tire pump and an air gage. If no leaks occur the surplus oil is drained off through the plug at the oil level and both plugs reinserted securely. By following this procedure we have not had a single switch filled with water in nearly ten years of service, and many have been submerged at times.


Standard Offset (Brick)
Plan (Section B-B) Detail 1
Elevation (Section A-A) Detail 2
Offset A / Interior B
3' 10'-3½"
4' 11'-8"
5' 13'-1"
6' 14'-4" (Not recommended)
Note: For 1 and 2 ft. offset use standard straight manhole
To nearest sewer
Standard 90-deg. (Brick)
Walls and ducts faces are symmetrical
Standard Straight (Concrete)
4" fiber duct
5/8" reinforcing rods
Minimum length may be used only where top ducts of each run differ less than 4" in elev.
Manhole frame and cover
60 lb. I-rail
Plan Section A-A Detail 1
Elevation Section B-B Detail 2
Standard 3-Way (Brick)
Note: Sidewall to be increased 6" in length for every foot change in A
Difference in duct elevation A / Width B
0 to 18" 7'-3"
2' 7'-7"
3' 8'
4' 8'-6"
Plan Section B-B Detail-1
Elevation Section A-A Detail-2
Straight Plan (Section B-B) Detail 1
90° Plan Detail 3
Service-Cable (Brick)
Elevation (Section A-A) Detail 2

Five manhole designs standardized in Detroit

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Right

When you "line up" with HEMINGRAY you line up these advantages:

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4. Unaffected by sudden temperature changes.
5. Withstand maximum insulator pin expansion.
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9. Tougher—withstand rough handling.
10. Clear and flawless for easy inspection.

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BRASS BUSHED HEMINGRAY

● Utilities from one end of the country to the other are buying these new *brass bushed* Hemingray Insulators—for greater economy and improved distribution service. This important insulator development adds to the dielectric properties of glass, an amazingly *greater mechanical strength!* The brass bushing insures perfect threads for uniform contact with pin—permits quick insertion to full length of threads—and safeguards the insulator completely against pin expansion. Ratings up to 15,000 volts. All styles made in clear and brown color. Samples and descriptive folder on request. Write to Owens-Illinois Glass Company, Hemingray Division, Muncie, Indiana.

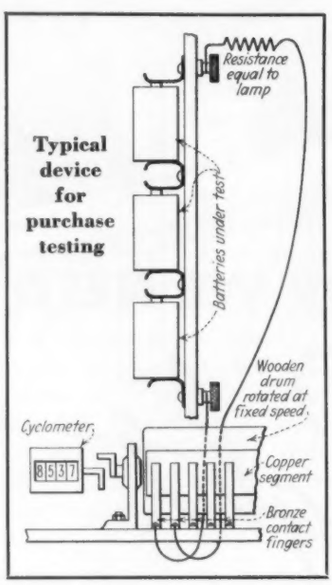
HEMINGRAY Glass INSULATORS

Testing Before Purchasing

By A. C. SACHSE

Dodge Division, Chrysler Motors, Detroit, Mich.

In a plant where recurrent electrical operations, such as contactor openings and closings, flashlight flashes, etc., run into numbers worthy of comparison with the dimensions of Betelgeuse, it is very much worth



while to be sure that the total of these operations is the maximum obtainable from what is paid for in the equipments and supplies responsible for them. For instance, in the Dodge plant of the Chrysler Motor Corporation at Detroit the annual purchase of flashlight batteries runs around 22,000. Thus, if one battery has 10 or 20 per cent more flashes in it than another, it will have been worth some trouble and expense to secure such interesting information.

All of which leads up to the observation that considerable purchasing money can be saved in pretty nearly every large industrial plant if the electrical shop contains several fractional-horsepower motors, a few cyclometer counters, an assortment of gears, pulleys, belts, etc., and, most important, sufficient human ingenuity to put together these bits of bric-a-brac into testing devices of various kinds. Since we have already mentioned definitely the total annual purchase of flashlight batteries in the Dodge plant, let us use for illustration the "dingus" that was rigged up for comparison of various makes of batteries as a guide in making the contract for their purchase. The same kind of device—power-driven drum contacts in various arrangements—can be used for tests on many types of recurrent operation equipments.

By means of bronze spring holders the usual team of three batteries is connected in series with a resistance equivalent to the regular lamp and with a pair of contacts pressing on the drum. With each rotation of the drum the circuit is closed once, the duration of closure depending on the rotation speed of the drum and the width of the copper segment—being set to a time that has been taken, arbitrarily of course, as that of an average flightlight operation. The cyclometer counts the number of operations and at intervals voltage readings are taken on the batteries. The curves of voltage plotted against number of operations for all the batteries included in the test make a graphic comparison of the different makes.

•

Electric Heat Speeds Production

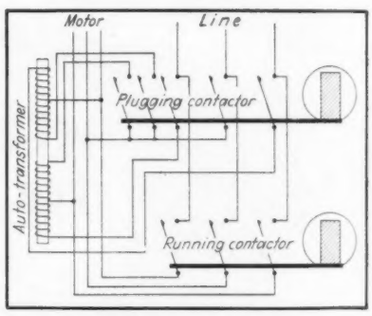
Thinner produced in a 500-gal. gas-heated still in a chemical plant manufacturing paint products had a cloudy appearance and an undesirable odor, reports Maxwell Cole, Philadelphia Electric Company, Philadelphia. Consequently an electric heating system was adopted consisting of clamp-on heaters applied to the bottom and sides of the kettle. Zone control was used for the bottom and two tiers of heaters. Insulation on the outer shell, with connections at the top of the kettle to a vacuum and condenser, completed the installation.

Better temperature control without danger of reaching the flash point of the solvents resulted. The desired product was obtained in less time and with greater safety with an input of 75 kw.

•

Motor Plugging Cuts Maintenance Time

Forming presses, such as are used so largely in automobile plants for shaping fenders, radiator shells, body sections and many other sheet metal parts, are not the kind of machine ordinarily considered as needing a plugging motor drive. Yet it has been found very much worth while to include a plugging arrangement in the



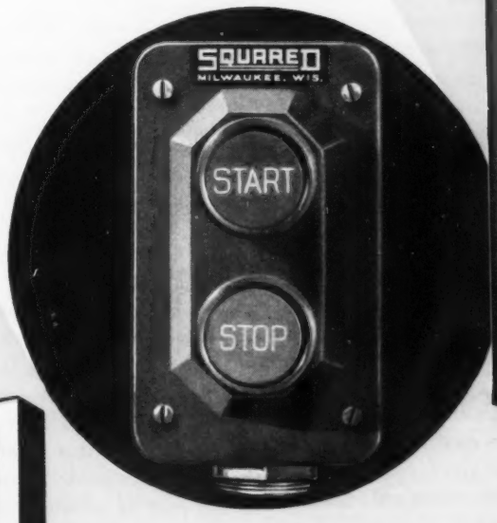
For plugging a forming press

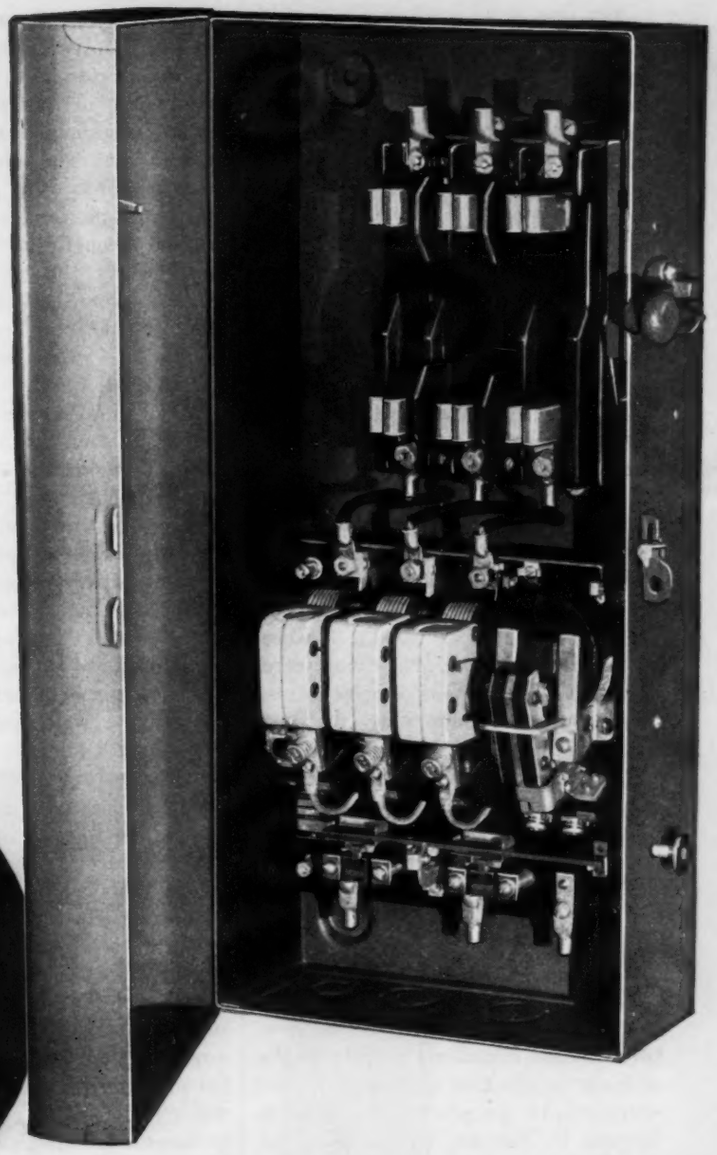
The five-arm contactor for plugging is electrically and mechanically interlocked with the running contactor. Plugging is at reduced voltage supplied from an air-cooled autotransformer. This transformer is put together in the plant electrical shop at very low cost, since neither efficiency nor any feature of performance other than approximate voltage ratio need be considered in its construction. It is to be noted that the center phase connection is through two contactor arms and that the transformer winding is in two distinct parts, separated from each other except when in operation. If the transformer windings and connections were not so disposed the short legs of the transformer would be in a continuous open delta connection at a higher than designed voltage.

main drive control on many of the presses in the Chevrolet pressed metal division at Flint, Mich., even though the plugging feature is used very infrequently.

A heavy flywheel, to carry the hump of the ultimate squeeze, is an integral part of this type of press. When current is cut off the motor it may take anywhere from 20 to 45 minutes for the flywheel to come to rest. This time is of no consequence if the press

the ORDERLY plant is an EFFICIENT plant





■ One glance over the interior of a manufacturing plant usually tells the story of its management. Its very appearance tells whether it is laid out for economy of space and an orderly flow of production.

Good plant layout inevitably increases the efficiency of both men and machines and—the proper distribution and control of electricity for illumination and power are important factors in planning the modern industrial installation. Too often they are not given the necessary consideration.

The Square D combination starter — disconnect switch, fuses and automatic starter in a single cabinet —is an economical unit of motor control. It requires less mounting space than separate switch and starter; it saves in installation cost because it is internally wired; its safety interlock avoids accidents; it provides push button control, low voltage and overload protection for the motor; and it makes a neat and efficient installation.

Square D safety switches and Square D motor control — there is no better electrical equipment.

CALL IN A SQUARE D MAN

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is being shut down at the end of the workday or otherwise by cessation of operation. But if the press is being shut down so that dies can be changed or any work, such as setting or honing, be done on them, then the time for the flywheel to stop is very important, for not only does it add to the period that the press is out of production, but also there may be three or four high-priced die makers standing around waiting to get to work. Of course, there is a clutch between the flywheel and the press jaws, but the only really safe time to work on a die is when there is no possible chance of the jaws coming together. And this is only when the flywheel is perfectly still. Therefore, in every well-operated press shop the inflexible rule is that the flywheel must be stopped before any man starts to work on a press die. And in these shops the flywheel on even the largest press now takes less than three minutes to come to rest. The simple manner in which the plugging arrangement is incorporated in the press control is shown in the accompanying drawing.

•

Electric Welding Aids Pipe Maker

Electric welding and controlled heating of dip-kettle service by electrical means contribute greatly to the uniform production of steel pipe for water-supply purposes, according to Vincent P. Marran, vice-president of the Walsh Holyoke Steam Boiler Works, Inc., speaking recently before the New England Water Works Association. Steel pipe up to 36 in. diameter is usually made in one plate per course. From 36 to 72 in. it is generally made in two plates with 30- to 36-ft. sections, joined together by welding on the longitudinal seams with no intervening girth joints. The plates are planned to exact dimensions so that when rolled the resulting pipe will be exact in circumference. The same process that prepares the plates also prepares the longitudinal seam to receive the weld and insures clean metal at all times.

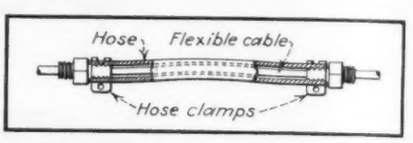
"The development of automatic welding," said Mr. Marran, allows us to make welds that are stronger than the plate itself and at the same time gives us an elongation approaching that of the parent metal. For metallic welding heavy-coated electrodes are used, and for carbon welding powdered flux is employed to form a gas-enveloped arc excluding oxygen from the molten metal and insuring a soft, machinable weld with high ductility and strength. Heavy currents are used to achieve these results and to develop the speed necessary to make this operation economical . . ." The dipping kettle is electrically heated and thermostatically controlled. The pipe is not preheated, but is put in the bath cold and allowed to remain until the steel reaches the same temperature as the dip. Mr. Marran said that this process costs a little more, by slowing down production, but that with careful procedure a smooth coating, tough and tenacious when cold and not liable to become brittle or scale off, can be obtained. As every coating has a critical dipping temperature for the best results, control by electrical means within plus or minus 5 deg., or even 1.5 deg. if necessary, insures uniform quality.

•

Water-Cooled Leads Save in Welding

By A. C. SACHSE
Dodge Division, Chrysler Motors, Detroit, Mich.

Maintenance of the water-cooled conductors that are draped in profusion about a modern multiple head automatic welding machine or hung in shallow looped pairs on the manually operated single welders is a considerable job and an expensive one. But the expense has been considerably reduced and work given to two men in the Dodge plant of the Chrysler Motor Corporation at Detroit by making up replacement conductors from materials easily available.

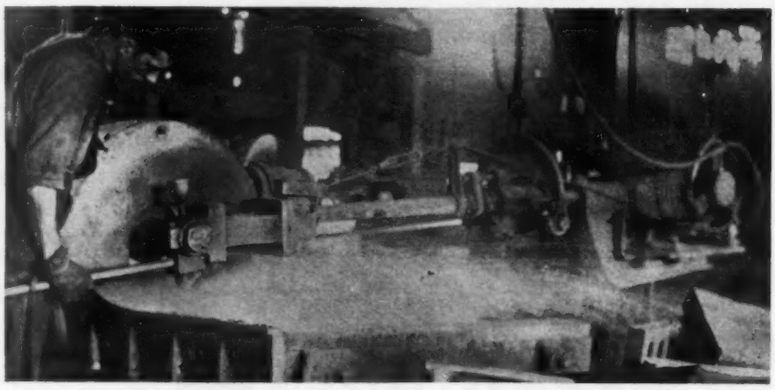


Hose, cable and spiral tubing make water-cooled lead

The regular type of water-cooled welder lead consists of a hollow cable on which is vulcanized a covering of rubber which acts doubly as insulator and water pipe. When, by abrasion or fatigue from bending, the rubber covering can no longer hold the water, the lead must be replaced. A discarded lead of this type has no more than copper junk value on account of the cost of revulcanizing and other repair operations. Thus, a new lead was indicated whenever one began to leak in service. But not any more in the Dodge plant.

Here is the solution: A piece of extra-flexible stranded bare copper cable is cut to the proper length. The common cable size is 500,000 circ. mil. The center strand of the cable is pulled out and replaced with spiral copper tubing which is not watertight. To one end of the cable is sweated the proper water connection lug and then a length of 1½-in. rubber hose is drawn on. The connection lug is put on the other end and the hose sealed with clamps to the lugs. When this cable springs aleak, which it does not any more often than the vulcanized type, it is a simple matter to replace the hose.

GRINDER DRIVE MOTOR SERVES ALSO AS COUNTERPOISE



Carborundum wheel at 9,000 r.p.m. with swing rig does rough snagging work on manganese and stainless steel castings. Chain block and gimbal suspension allows freedom for swing up and down and over large area

SALES OPPORTUNITIES IN NEW CONSTRUCTION

ST. LOUIS, MO.—Laclede Power & Light Company is arranging financing for extensions and improvements early in 1936 to cost about $3,500,000, of which about $2,400,000 will be used for new steam-electric generating plant, $300,000 for line extensions and betterments, and remainder for other miscellaneous expansion and improvements. Management & Engineering Corporation, 327 South La Salle Street, Chicago, Ill., is engineer.

BARBERTON, OHIO—Columbia Alkali Corporation, New York, N. Y., plans installation of heavy-duty motors and controls, regulators, conveyors, electric hoists, etc., in new addition to plant at Barberton for chlorine production. Cost is over $1,000,000. H. K. Ferguson Company, Hanna Building, Cleveland, Ohio, is engineer. Company is affiliated with Pittsburgh Plate Glass Company, Pittsburgh, Pa.

KETTLE RIVER, MINN.—Northern Co-Operative Power Association, care of Theodore Ross, Kettle River, secretary, recently organized, plans transmission and distributing lines for rural electrification project in vicinity of Kettle River, Cromwell and Moose Lake, with power substation and service facilities, totaling about 200 miles. Cost $350,000. Financing is being arranged through Federal aid.

STARKVILLE, MISS.—Closes bids December 2 for equipment for city-owned electric power plant, including engine-generator units and accessories, electrical distribution lines, street-lighting system and miscellaneous equipment. Fund of $150,000 has been secured through Federal aid. A. S. Brumby is engineer.

ORANGE, TEX.—Equitable Paper Bag Company, 314 Scholes Street, Brooklyn, N. Y., plans installation of motors and controls, conveyors and other equipment in paper mill at Orange, where company has acquired former plant of Commercial Pulp & Paper Company and will remodel and improve; power plant will be modernized and new equipment installed. New company to be known as Orange Pulp & Paper Company has been organized to carry out project. Cost close to $125,000. Frederick L Smith, 21 East Fortieth Street, New York, N. Y., is consulting engineer.

DENVER, COLO.—Bureau of Reclamation, Denver, receives bids until November 29 for one 138-kv., 600-amp., three-phase outdoor type oil circuit breaker; three 138-kv., 600-amp., three-pole, single-throw, gang-operated, disconnecting switches; and for one three-pole 138-kv., lightning arrester for switchyard for Boulder power plant, Boulder Canyon Project, California-Arizona-Nevada (Specification 744-D).

SAVANNAH, GA.—Savannah Electric & Power Company is having plans prepared by Stone & Webster Engineering Corporation, Boston, Mass., consulting engineer, for proposed extensions and improvements in steam-operated electric power plant, to include installation of new 7,500-kw. turbo-generator and auxiliary equipment. Cost about $350,000.

LOS ANGELES, CALIF.—General Motors Corporation, Detroit, Mich., plans installation of motors and controls, regulators, power substation equipment, electric hoists and other equipment in new assembling works at South Gate, Los Angeles, for Buick, Oldsmobile and Pontiac automobiles. Cost close to $2,000,000.

WINCHESTER, VA.—Is having surveys and estimates of cost made by Burns & McDonnell Engineering Company, 107 West Linwood Boulevard, Kansas City, Mo., consulting engineer, for proposed new city-owned electric light and power plant.

LOUISVILLE, KY.—Kentucky Rural Electrification Company, Edward White, McDowell Building, president, recently organized, plans transmission line from Flemingsburg to Sherbourne, Ky., by way of Hillsboro and Tilton, about 30 miles, and from Beattyville to Booneville, about 11 miles, with distributing lines throughout area for rural electrification. Cost about $75,000. Financing is being arranged through Federal aid.

DETROIT, MICH. — Koppitz-Melchers, Inc., 2169 East Atwater Street, brewer, plans power plant in connection with new multi-unit brewery on 2-acre tract of land on Dubois Street. Cost about $1,000,000. Mildner & Eisen, Hammond Building, are architects and engineers.

RIVERSIDE, CALIF.—Southern Sierras Power Company plans extensions in transmission and distributing lines in Imperial Valley district, including additional power substation units. Financing for $259,000 has been arranged for project.

MINNEAPOLIS, MINN. — Minneapolis-Honeywell Regulator Company, 2727 Fourth Avenue South, plans installation of motors and controls, conveyors, etc., in new six-story addition to heat-regulator equipment manufacturing plant. Cost about $200,000. E. J. Prondzinski, Pence Building, is architect.

TORONTO, ONT.—National Cash Register Company of Canada, Ltd., Bloor Street West, a subsidiary of National Cash Register Company, Dayton, Ohio, plans installation of motors and controls, conveyors and other equipment in new local plant on Lansdowne Avenue. Cost about $300,000.

COLUMBIA, S. C.—State Santee-Cooper Authority, Burnet R. Maybank, mayor, Columbia, chairman, has engaged Parsons, Klapp, Brinckerhoff & Douglas, 142 Maiden Lane, New York, N. Y., consulting engineers, to make surveys and preliminary plans for proposed hydroelectric power and navigation projects on Santee and Cooper Rivers, for which initial appropriation of $500,000 has been secured through Federal aid. Two large hydroelectric generating stations are proposed, with power transmission lines to different points. Entire project is estimated to cost $37,500,000.

SANTA MONICA, CALIF. — Douglas Aircraft Company plans installation of motors and controls, electric hoists, conveyors, etc., in new addition to airplane manufacturing plant. Cost about $200,000. Ellis W. Taylor, 803 West Third Street, Los Angeles, is consulting engineer.

GREENFIELD, OHIO — Is completing plans for extensions and improvements in city-owned electric power plant, to include installation of new 750-kw. turbo-generator and accessories, two exciter sets, superheaters and other equipment. Walter I. Barrows, Reibold Building, Dayton, Ohio, is consulting engineer.

GERING, NEB.—Gering Valley Rural Public Power District, L. H. Sloan, Gering, vice-president, recently organized, has secured fund of $97,000 through Federal aid for rural electrification project in vicinity of Gering, comprising about 68 miles of transmission and distributing lines, with service facilities. Proposed to begin work soon.

ROCHESTER, N. Y.—Rochester Gas & Electric Company plans rural electrification program in 1936, including installation of transmission and distributing lines in Wyoming, Allegany, Livingston and other counties, totaling about 500 miles in all, with power substation and service facilities. Cost $700,000. Permission has been secured.

DEPENDABILITY *low maintenance cost*

The simplicity of operation of Lincoln Demand Meters results in dependability and low maintenance cost. In Lincoln Demand Meters, only one simple unit, comprising of a shaft and pointer and two bimetallic coils, moves—and that SLOWLY. They are free of timing mechanisms and of all rapidly moving parts.

LINCOLN DEMAND METERS

Watt Demand and Ampere Demand meters for every requirement. Indicating or Graphic.

INDEPENDENT OF THE WATTHOUR METER

Lincoln Demand Meters operate independently of the watthour meter. They are merely connected to the same load. One type of Demand Meter for any make or type of Watthour Meter.

LINCOLN METER CO., Inc. Springfield, Illinois

NEW ENGINEERING IDEAS

THEORY • DESIGN • MANUFACTURE • CONSTRUCTION • UTILIZATION

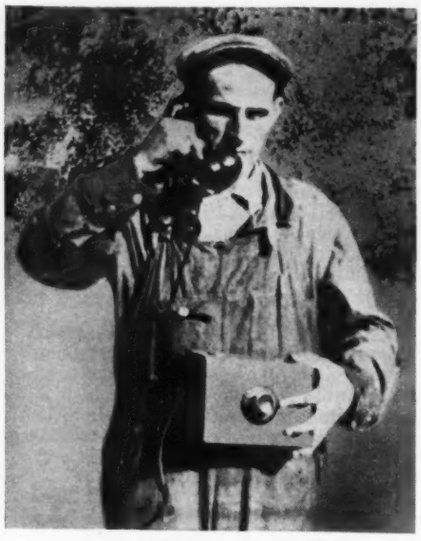
Ultra-Short-Wave Communication

By FRED HAITZ, Jr.
Sioux City Gas & Electric Company,
Sioux City, Iowa

Two-way radio communication between utility company service crews and dispatchers during storms is now possible by means of high-frequency sets operating on wave lengths between 5 and 10 meters. Radios operating at ultra-high frequencies possess certain advantages, one of which is the freedom from atmospheric disturbances. Some of the combination transmitter-receivers are no larger than an ordinary engineers' handbook and require a minimum amount of power for their operation.

Tests were made on the system of the Sioux City Gas & Electric Company with two inexpensive commercially available outfits. These sets sell for about $15, exclusive of batteries and French type telephone handsets. A makeshift antenna was strung up on the ground floor of one of the operating offices. A second set was placed in a car with the antenna lying on the top. Loud speaker volume was obtained while the car cruised within a radius of 2 miles. Coverage of the entire city was accomplished by increased elevation of the antenna with the same type of outfit that previously had given only a 2-mile range at ground level.

In the testing on the Sioux City system two types of commercial sets and two home-made outfits have been tried out. Conclusions derived from the tests so far conducted are that the only important interference is from automobiles, which at times radiate their ignition noises for half a block. The super-regenerative type of receiver must have a stage of radio frequency to prevent interference to other sets in the short-wave bands. Type of antenna used is very important. The height of the transmitting and receiving antennae is more important than an increase in power. Other tests are being planned, one of which will be with an 8-ft. rod antenna placed on top of a 265-ft. smokestack. With this arrangement it is expected that a territory several miles in radius will be covered very easily.



The line foreman reports

Arrangement may be made whereby the operator talks and listens without throwing a switch. He can interrupt the conversation at will or break in. A dynamotor running from a car battery will supply "B" current for the set.

Lightning Current Magnitude Confirmed

Analysis of 130 cathode-ray oscillograms showing magnetic field variations due to natural lightning surges indicate that the usual maximal current values of lightning vary between 20 and 40 kiloamperes, the usual duration of such pulses being from 10 to 30 microseconds. These investigations, conducted by Dr. Harald Norinder at the University of Uppsala, Sweden, are reported in a paper appearing in the *Journal* of the Franklin Institute for July, 1935.

Lightning was found to be constituted of a sequence of partial and similar discharges of varying intensity. In some cases positive partial current was followed by two or three negative ones. Discharges were considered positive when a positive charge was carried from atmosphere to earth and negative when a negative charge was carried to earth. The percentage distribution of the values for positive and for negative discharges are reproduced in Fig. 1 (a) and (b). The tendency is toward predominant negative current values, as is shown by the fact that the average maximal current value for negative surges was reported as 54 ka., against 47 ka. for positive currents.

Maximal changes of current with time are shown in Fig. 2 (a) to be 1 to 3 kiloamperes per microsecond or 4 to 6 kiloamperes per microsecond. The extreme values of 20 to 30 kiloamperes per microsecond did not, as would be expected, occur very often;

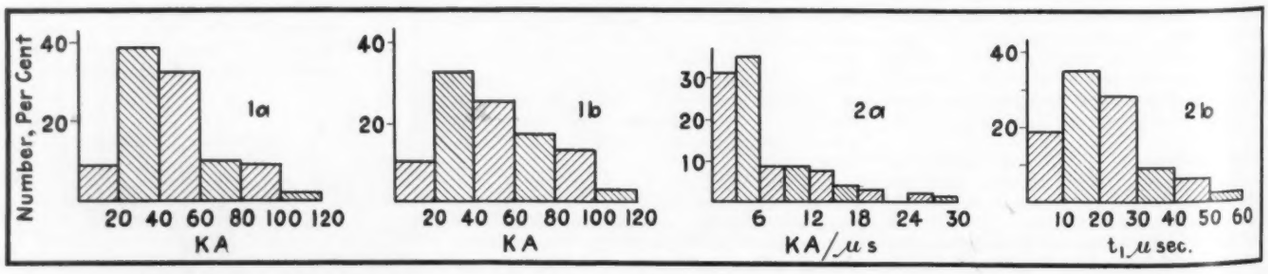
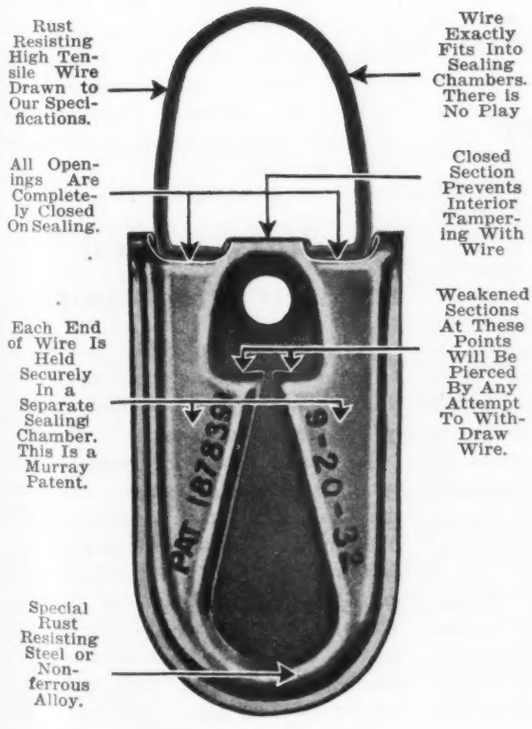


Fig. 1—Percentage distribution of crest values of individual lightning pulses—(a) positive, (b) negative

Fig. 2—(a) Maximal changes with time in lightning currents. (b) Duration of time of individual current pulses

One sure way to catch the meter manipulator!


Rust Resisting High Tensile Wire Drawn to Our Specifications.
Wire Exactly Fits Into Sealing Chambers. There is No Play
All Openings Are Completely Closed On Sealing.
Closed Section Prevents Interior Tampering With Wire
Each End of Wire Is Held Securely In a Separate Sealing Chamber. This Is a Murray Patent.
Weakened Sections At These Points Will Be Pierced By Any Attempt To Withdraw Wire.
Pat 1878399-20-32
Special Rust Resisting Steel or Non-ferrous Alloy.

CONSTRUCTION DETAILS OF THE TAMPERPROOF MURRAY PADLOCK SEAL

Dollars will continue to be lost through current diversion, just as long as meters are not adequately protected against the meter manipulator.

There's one sure way to catch the meter manipulator—install tamperproof Murray Padlock Seals and detection becomes positive.

This time-tried seal has 7 definite advantages in construction—7 reasons why it gives more reliable protection against the kilowatt thief.

Over 1200 central stations have specified the Murray Padlock Seal and proved its effectiveness.

Meter superintendents all over the world know the Murray Padlock Seal—know that its unique construction makes it tamperproof, so that detection is positive.

Write for samples and full details.

METROPOLITAN DEVICE CORPORATION
1250 Atlantic Avenue, Brooklyn, N. Y.

Without obligation—send details of Murray Padlock Seal-ing system—samples and price sheet.

Name .....

Company .....

Address .....

the average current pulse lasted from 10 to 30 microseconds.

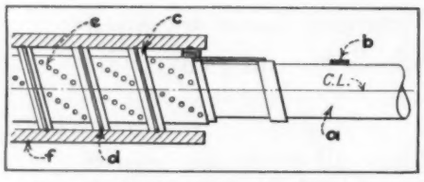
Contrary to earlier estimates, which placed lightning current charges at 25 to 50 coulombs, observations made by Dr. Norinder placed the charges in lightning pulses below 2 coulombs. These low values were a necessary consequence of the short duration time of the discharges measured in the partial discharges.

•

Gas-Cushion Cable Has Reduced Size

Development of a gas-cushioned underground transmission cable by W. T. Henley's Telegraph Works Company, Ltd., England, has resulted in a cable for which is claimed a marked reduction in cost, size and weight over solid cables for the same service. Though the cable is filled with an inert gas under several times atmospheric pressure, accidental damage or cutting of the cable for jointing causes but little loss of gas.

As described in a paper before the international conference on high-voltage transmission networks the cable is an armored cable which can be laid directly in the ground. The paper dielectric is impregnated after application to the conductor. A subdivided and screened space between the dielectric and the lead sheath provides accommodation for storage of gas under pressure. Gas cushions thus formed prevent ionization due to voids in the dielectric and permit local expansion and contraction of the cable compound with changing load.



Longitudinal section of gas-cushion cable

(a) Cable core insulated in usual way, (b) inner half of spiral spacer consisting of piled paper strips, (c) outer half of spiral spacer, (d) metal strip binder holding spacer to core, (e) seal control, a wide strip of perforated paper built up half way through the gas cushion space to facilitate sealing the individual turns of this space, (f) lead sheath.

Spiral spacers are wound around the cable core over the impregnated paper dielectric and are held in position by a narrow metal strip sealed to the lead sheath by a low melting point alloy. To prevent the flow of gas around the spiral space in the event of damage to the cable a viscous sealing compound is introduced into the space between the lead sheath and the seal control shown in the figure. This sealing compound gravitates through the holes in the seal control from the outer half of the spiral space, where it is introduced, into the lower part of both halves of the gas chamber, thus forming a complete seal in each turn of the spiral space.

Experience has shown that at working voltages of 33 kv. the chief advantage of this type cable is in weight reduction. The cost of the gas cushion offsets to some extent the reduction in dimensions. However, at voltages around 66 kv. there is a considerable saving in cost as well as a reduction in section. At 66 kv. an 0.35-sq.in. gas-cushion, single-core cable with an over-all diameter of 1.977 in. would be suitable for transmitting 450 amp., whereas an 0.5-sq.in., solid-type cable with an over-all diameter of 2.801 in. would be needed for the same duty. The gas-cushion cable may safely work at 75 deg. C., as against 65 deg. of the solid type. A 150-kv. cable of this type is being installed in Holland.

•

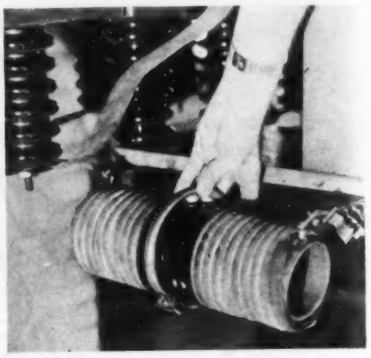
Falling Weight Recloses Breaker

A falling weight is used successively to reclose contacts of a new circuit breaker designed for use on distribution systems. This British device is described in the *Engineer* of June 28, 1935. The operating mechanism consists of a spring-loaded weight attached to an endless chain which passes over two sheaves, one of which drives the operating shaft, the other running idle. The weight travels 18 in. for each reclosure operation, and any number of operations may be arranged at one setting, depending on the travel available.

An interval of from 10 to 48 seconds between successive operations may be obtained by adjustment. An automatic clutch engages the falling weight during the resetting and catches to declutch the retarding mechanism at the correct moment, insuring quick and complete closure. The retarding mechanism comprises a train of gear wheels engaged with pinions driving an escapement, a system adopted in preference to dashpots, to insure consistent and reliable timing.

High-Voltage Surge Deforms Copper Strap

Flat bands of copper have been turned into tubes in a few millionths of a second at the Westinghouse Laboratories by inducing a momentary high-current, high-frequency surge in them.



Copper strap stretched and curled into semi-cylinder by high-current, high-frequency surge

A 1-in. wide $\frac{1}{32}$-in. thick soft copper strap was tightly clamped around a $4\frac{1}{2}$-in. diameter 12-in. long coil consisting of 24 turns of No. 9 cable. A high-voltage generator sent a 50,000-amp., 100,000-volt surge at 190 kilocycles through the coil. Interaction of flux and current simultaneously curled the one-turn short-circuited secondary and increased its diameter about an inch.

•

Conduit Located in Concrete Floor

A simple and effective method of locating the exact course of metal conduit set in concrete was used recently in a large power house.

In pouring concrete some of the conduits became plugged. Since no one knew the exact location of the pipes in the floor and walls, the problem was to locate them without digging up large parts of the flooring. The pipes were located exactly by connecting the electrodes from a welding set to the ends of the pipe and using an ordinary compass. The service department of the Canadian Westinghouse Company was then able to draw a chalk line directly over the pipe in trouble. A fish tape was used to measure the distance from the ends to the plugged portion of the conduit. This made it possible to break out the concrete directly at point of obstruction.

Burroughs

TO EMPLOYERS

who find it necessary to keep more detailed information on

PAYROLL and EARNINGS RECORDS

of individual employees

While considering ways and means to meet new requirements for information about the earnings and deductions of individual employees, why not profit by Burroughs' experience and recent machine developments?

There are many new styles of Burroughs machines for handling this work. They compute the earnings, prepare individual earnings record, payroll sheet, pay check or pay envelope, all in one operation. They also automatically accumulate such statistics as hours, earnings, various deductions, and net pay for any period. In fact, much of this information can be obtained as a by-product of the regular work of these machines.

Let us show you how we have helped other employers; how your problem can be met with minimum change in equipment, and at the lowest possible accounting cost. There is no charge for this service, no obligation on your part. Telephone the local Burroughs office, or write direct to

BURROUGHS ADDING MACHINE COMPANY
DETROIT, MICHIGAN

ADDING, ACCOUNTING, BILLING AND CALCULATING MACHINES
CASH REGISTERS • TYPEWRITERS • POSTURE CHAIRS • SUPPLIES

BUILDING UP THE LOAD

APPLIANCES, LIGHTING AND POWER • DOMESTIC • COMMERCIAL • INDUSTRIAL

Automatic Lunchroom Has Electric Service

Idaho Power Company has co-operated in the development of an electrified "restaurant without waiters" in Boise. It has met with instant popularity, because it provides fast service and an unlimited quantity and variety of food selection for its patrons. There is a most desirable load for the power company.

A continuous driving chain travels within a glass-inclosed runway, moving longitudinally through the center of a long kitchen, up a shaft and back along the center lunch counter of the restaurant. Driven by the chain are 137 steel carts, each of which carries a conventional-sized serving tray. These carts are loaded with all items of the menu in the kitchen, travel through the restaurant, where patrons make a selection as they pass by their seats, and then back into the kitchen, where the carts are refilled. As the customers finish with their dishes a small aperture at each place can be opened and the dishes placed on a traveling belt that carries them into the kitchen.

In the kitchen every appliance is run by electricity, as are all of the traveling serving belts. In addition a trolley is carried around the runway and trays of hot dishes are kept hot during the trip by means of 1,500-watt heaters in the top of the metal carts, a sliding contact on each cart providing the necessary supply of energy from the bare trolley wire.

This new restaurant, built by the Automatic Food Machinery Corporation, simplifies restaurant operation and reduces operating costs. By charging a flat rate and providing a wide variety of food displayed on the trays for personal selection by the patrons public acceptance is assured. From the electrical standpoint this load, representing approximately 30 kw. connected, has a very high load factor, as much of the equipment operates continuously.

An endless service chain carries trays from this kitchen to the lunch counter for self-service, with every other tray kept hot by electric heaters, in this Boise restaurant

Load Building on a Five-Year Plan

By W. C. MAINWARING
Merchandise Manager,
British Columbia Electric Railway
Company, Ltd., Vancouver, B. C.

To bring major electrical appliances within the reach of every family, the British Columbia Electric Railway Company, Ltd., has initiated a long-term-payment plan which permits customers to buy electric ranges and water heaters for $1.50 and $2 a month, respectively. The plan is confined to domestic customers in single-residence dwellings and has some unusual aspects.

The company, through its stores, is offering a standard model electric range which will be sold to the customer at an installed price of $160. When the contract is signed the customer pays three monthly payments of $2 each in advance, the next payment not being due until after the fourth month. After the customer has made 65 consecutive monthly payments of $2 each, thereby paying $130, the company cancels the balance of the contract, amounting to $30, and gives the customer a receipt in full for the range. Should the customer's house be wired for the range the contract price of the range is $120, the customer paying 60 consecutive monthly payments of $1.50 until a total of $90 has been paid, at which time he is given a receipt in full and the contract canceled as above.

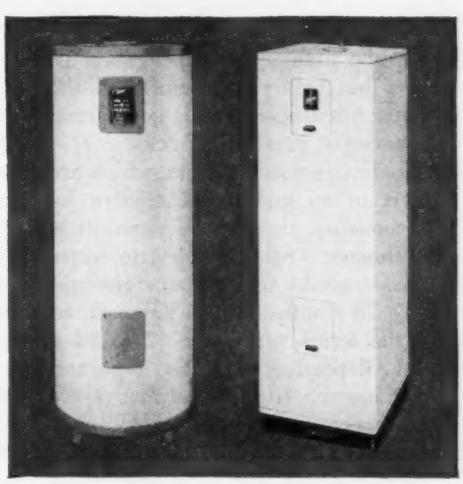
Dealer approval of the long-term financing plan is assured by allowing dealers to take orders for the standard model, the utility making the installation and collecting the monthly installments. Dealer compensation for the range sale is $12, paid in semi-annual payments of $3 each, commencing six months after the installation of the sale. In other words, the dealer only has to secure the application from the customer in order to receive his payment of $12, the company handling the entire transaction from that point. On all ranges sold under the plan the company accepts full responsibility in

Constant current consumption, too... the tank is made of *non-rust* Everdur

Why should you sell or encourage the sale of water heaters equipped with tanks in which rust will form... to discolor the water, reduce efficiency, and in time cause the tank itself to fail? In many sections of the country this happens all too often, resulting in consumer dissatisfaction, increased servicing expense, and an interrupted sale of current.

A tank of Everdur Metal assures a dependable source of rust-free hot water...not for just a few years, but *indefinitely.* For Everdur, an unusual alloy composed principally of copper, is as strong and easily welded as steel, and lends itself to economical, virtually "one-piece" tank construction. It *cannot* rust!

These features appeal to homeowners. For most people will pay a little more to get much greater value. These same features explain why leading heater manufacturers equip rust-proof models with tanks of strong, *rustless* Everdur.



Round type and square type "SEPCO" electric water heaters, made by Automatic Electric Heater Co., Pottstown, Pa. Hot and cold water connections are seamless copper tubing; all fittings are brass. And . . . every "Sepco" heater is available with an all-welded tank of *non-rust* Everdur Metal.

•

EVERDUR METAL—"Everdur" is a registered trade-mark identifying products of The American Brass Company, made from alloys of copper, silicon and other elements.

THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Connecticut

Offices and Agencies in Principal Cities

ANACONDA
from mine to consumer

8567

EVERDUR METAL *for* TANKS

Type of newspaper advertising being featured in the British Columbia range campaign

connection with servicing and the one-year guarantee on all ranges sold under the plan. After the guarantee period has expired customers of the long-term rental plan will be charged for service at prevailing rates.

On electric water heaters, which are subject to an intensive campaign by this company, the time of payment is even longer. Sales of electric water heaters made by the company are subject to 78 months of time payment, so that the terms vary from $2 to $3 a month, depending upon the type and size of heater. In the event that repossessions occur, the customer loses all monthly payments and any trade-in allowance which may have been made on a coal or wood range.

The 1935 long-term financing sales plan is applicable to all the territory supplied by the company, and it is expected that these low payments will convert many customers to the conveniences of electrical appliances. The success of the plan is assured by its thorough co-ordination with other branches of the industry and the intensive advertising campaign carried on in conjunction with the sales effort.

Campaign Built Around Dealers

A five-weeks co-operative electric washer and ironer campaign, covering five counties centering on Philadelphia, was recently closed in which seventeen distribution members of the Philadelphia Electrical Association, representing sixteen makes of equipment, reported a total sale of 3,490 washers and 447 ironers. This represents a 27 per cent increase of washer sales and an 88 per cent increase of ironer sales campared with their August, 1935, sales. Four hundred and seventy-two retail dealers actively participated in the campaign. In addition to the sales closed, many prospects were developed for follow up.

The success of the campaign, conducted by the association, was due to the backing of sixteen manufacturers, the co-operation of so many dealers and the method of creating public interest.

Promotion of the campaign was concentrated in 48 radio programs over three prominent Philadelphia stations. Featured in these programs was a contest based on the question, "Why Family Laundry Should Be Done at Home." Entrants in the contest were asked to write 50-word answers, the best each week being given the choice of a washer and ironer from sixteen available makes. The public was advised that the entries had to be made on blanks obtainable from dealers displaying the association campaign banner. Furthermore, they were told that listening to all the broadcasts would aid them in their answers.

To serve as the focal point for distribution of these blanks and thereby have the opportunity to interest a large number of people in their equipment, dealers had to agree to several things: (1) To attend special sales meetings in which they were given the best sales practices and shown how to make the most effective demonstrations; (2) to make every effort to sell both units; (3) to display the association slogan, "Modernize Your Home With Complete Electric Laundry." As an extra inducement, the dealer whose name appeared on the prize-winning entry blank each week received a $25 bonus. Preliminary publicity to dealers emphasized how the campaign was to be definitely tied up with co-operating dealers and how the public was going to be made "electric-home-laundry" conscious, so dealers could capitalize on the prospects attracted to their stores.

•

Finances Dealers' Installment Sales

The Potomac Electric Power Company, Washington, D. C., has completed arrangements whereby it can offer financial facilities for conditional-sale contracts to the members of the Electric Institute, in connection with the sale of recognized electric appliances. Financing will be at rates approved by the Federal Housing Administration under the National Housing Act. The electric appliances on which applications for financing will initially be considered are: Refrigerators, dish-washing machines, clothes-washing machines, ranges, water heaters, ironing machines, air-conditioning machines, furnace burners and stokers and built-in electric kitchens.

Financing will be for contracts having maturities ranging from one to three years and for minimum amounts ranging, respectively, from $50 to $150. Larger amounts may be financed under any of the maturities, and in certain instances contracts for longer maturities will be considered. It is intended to purchase contracts without down payments thereon and without recourse against the seller of the appliance.

The financing is naturally limited to contracts with customers of the Potomac Electric Power Company or Braddock Light & Power Company.

Co-operating dealers displayed this slogan

YOU MAY NEVER NEED IT
—But They Have It Just The Same

THE MORE-THAN-REQUIRED HORSEPOWER you get in every "Linc-Weld" motor is there for your protection... as a safeguard against failure... as a surety of long, carefree operation... as a guarantee of more dependable service for your money.

"Linc-Weld" gives you this extra capacity without sacrifice of power factor or efficiency. Every "Linc-Weld" feature contributes its share to make this possible.

"Linc-Weld's" arc welded frame is built of sky-scraper construction—rolled steel for greatest strength and rigidity with least bulk.

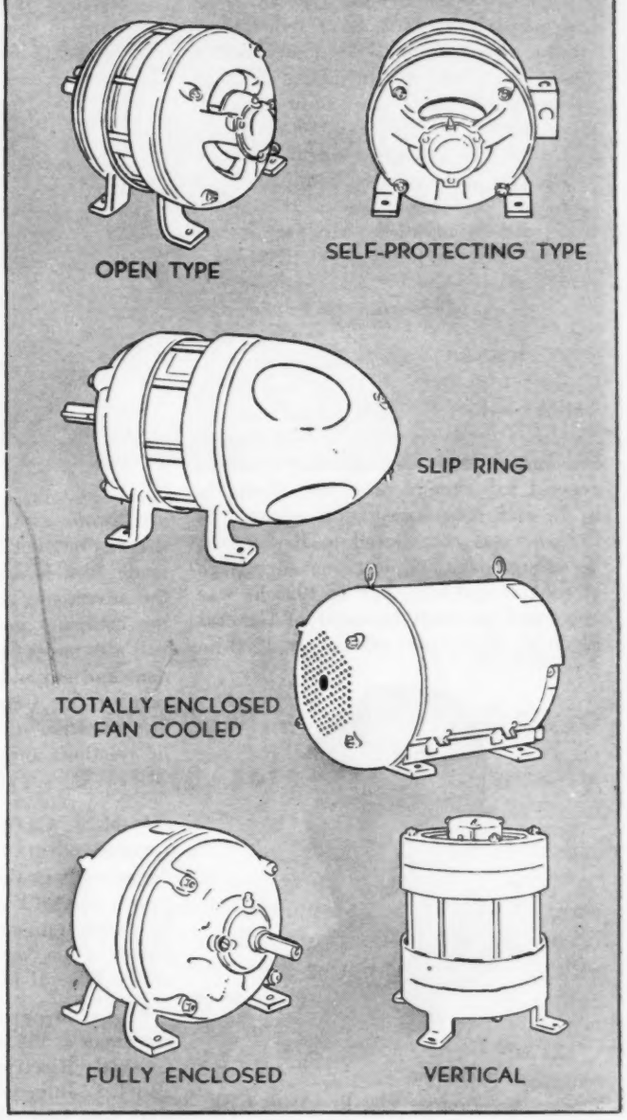
"Linc-Weld's" stator laminations are 28-gauge high silicon steel, heat treated.

"Linc-Weld's" waterproof insulation is permanently pliable—will never dry out or crack. It protects against attacks of dust, dirt and acid fumes.

"Linc-Weld's" rotor is statically and dynamically balanced.

"Linc-Weld's" performance proves the value of all these features.

We suggest if you want more for your money when you buy motors, that you find out about "Linc-Weld's" many advantages. Write THE LINCOLN ELECTRIC CO., Dept. U-18, CLEVELAND, OHIO.



LINCOLN
"LINC-WELD" MOTORS

LAD: "Why be down in the mouth about things—it's a simple matter to get your face lifted."

POP: "But the trouble is to keep it that way when you read the news out of Washington. I wish they would give us permanence to any face lift, the way 'Linc-Weld' gives it to carefree motor operation."

MEN OF THE INDUSTRY

C. E. Wilson Assumes New Duties; Quinn Resigns

Charles E. Wilson of Bridgeport, vice-president in charge of the merchandise department of the General Electric Company, has been assigned responsibility for the direction of all appliance activities of the company. In taking on these duties he assumes the additional responsibilities heretofore directed by T. K. Quinn, who as vice-president has been in charge of specialty appliances at Cleveland and chairman of the appliance sales committee. Mr. Quinn has resigned and on January 1 will become president of Maxon, Inc., advertising organization of Detroit, Cleveland and New York.

Mr. Wilson became associated with General Electric in 1917 in connection with the acquiring of conduit business by the latter company at New Kensington, Pa., and in 1918 was appointed assistant general superintendent of the Maspeth, L. I., and New Kensington works. In 1923 he was transferred to Bridgeport, becoming managing engineer in charge of conduit and wire, and in 1925 he was appointed assistant manager of General Electric's Bridgeport works. In 1928 he

C. E. Wilson

became assistant to Vice-President C. E. Patterson of the merchandise department and in less than two years he was appointed manager of the merchandise department in charge of engineering, manufacturing and sales. At the end of 1930 he was made vice-president and a member of the newly formed appliance sales committee of the company. In his new position Mr. Wilson will divide his time between the Bridgeport and New York offices of the company and will be principally concerned with radios and merchandising products at Bridgeport, refrigerators, electric ranges and specialty appliances at Cleveland and with air-conditioning apparatus manufactured in Bloomfield, N. J.

Mr. Quinn was first employed by General Electric in 1911. "We have a high appreciation of the work that Mr. Quinn has done in the 24 years of his association with the company," President Ger-

T. K. Quinn

ard Swope said, "and are happy to say that a retainer arrangement has been made with him, whereby in addition to the advertising work that he will do for the company in his new connection he will also assist Mr. Wilson and the president and any other part of the organization of the General Electric Company in connection with any questions of public relations and sales promotion."

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▶ M. T. CRAWFORD, formerly general superintendent of the light and power department in the central district of the Puget Sound Power & Light Company, has been appointed assistant chief engineer of the company with headquarters at the general office in Seattle.

▶ GERARD SWOPE has resigned as chairman of the board of directors of the General Electric Supply Corporation and J. L. BUCHANAN, formerly president, has been elected chairman to succeed Mr. Swope. J. L. BUSEY, formerly manager of sales of the appliance sales division of the merchandise department of the General Electric Company, has been elected president of the General Electric Supply Corporation.

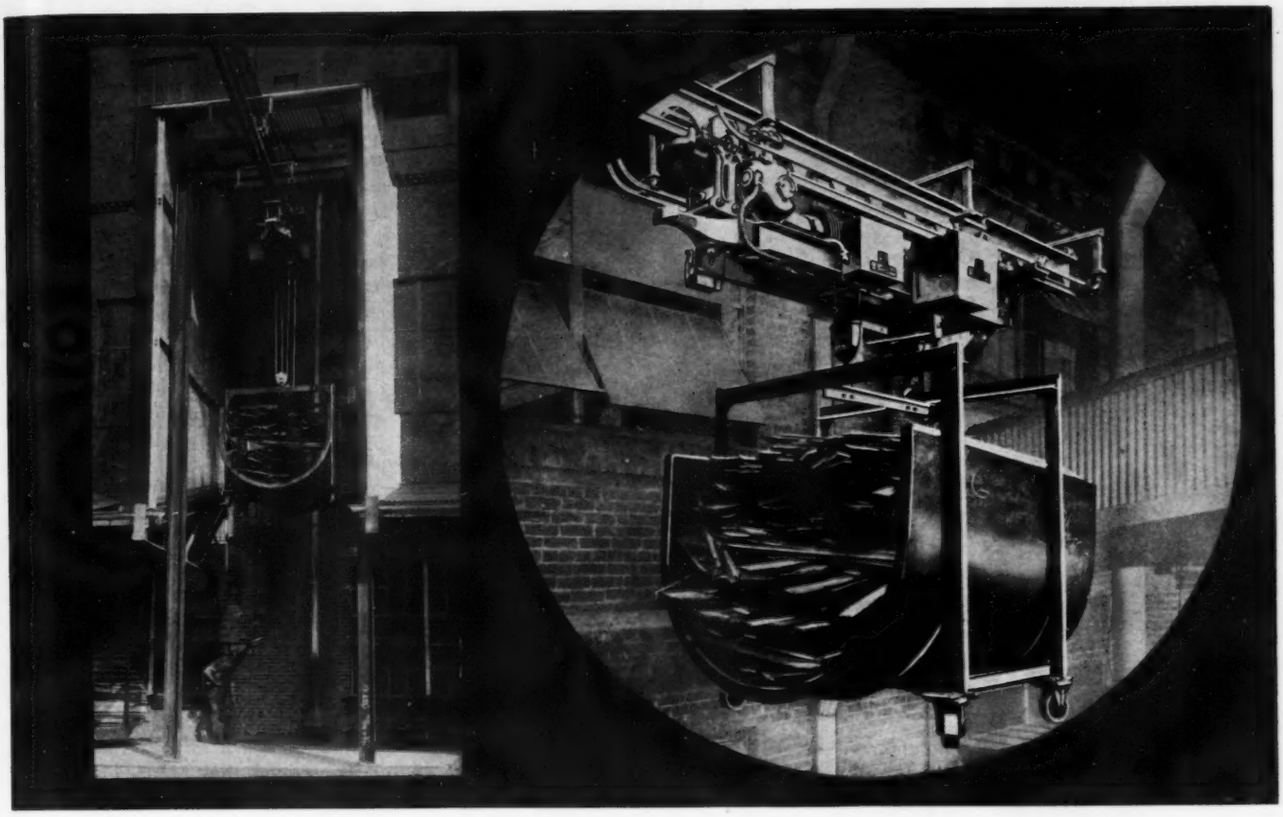
▶ W. H. GIBB has resigned as vice-president and from an active interest in the Thomson-Gibb Electric Welding Company, Lynn, Mass., and Bay City, Mich., to organize the Gibb-Lewis Company with headquarters in Chicago. The new company will deal in patents and patented articles. Mr. Gibb will continue to serve on the board of directors of the Thomson-Gibb Company.

▶ J. W. CORNELL has been appointed a member of the Idaho Public Utilities Commission for the term expiring January, 1941. He is succeeding J. D. Rigney.

▶ W. M. HAMMOND has been engaged by the Securities and Exchange Commission to take charge of the drafting of a uniform system of accounts for holding companies and mutual service companies subject to the jurisdiction of the commission under the Public Utility Holding Company Act. Mr. Hammond was formerly chairman of the committee on statistics and accounts of public utilities of the National Association of Railroad and Utilities Commissioners. He was also chief accountant of the Illinois Commerce Commission. During the past year or more he has been in private accounting practice with offices in Chicago.

▶ WILLIAM MCCLELLAN, president of the Potomac Electric Power Company, has been made president of the Washington Railway & Electric Company, Washington, D. C., to succeed William F. Ham, resigned. Mr. Ham had been president of the company since 1918. He first became connected with the Washington property in 1899 as controller. Later he became treasurer and in 1911 first vice-president and a director of the company. Two years ago Mr. Ham resigned as president of the Potomac Electric Power Company, controlled by Washington Railway & Electric, becoming chairman of the board. Mr. McClellan has been a prominent figure in the utility industry for a number of years. His experience has included the operating management of electric power companies as well as construction and other phases of electrical engineering. He is a fellow and past-president of the American Institute of Electrical Engineers.

▶ COL. THEODORE B. PARKER, director of the P.W.A. in Massachusetts since June, 1934, and for eleven years principal hydraulic engineer of the Stone & Webster Engineering Corporation, Boston, has been appointed supervising construction engineer of the Tennessee Valley Authority, with headquarters at Knoxville. He assumed his new duties November 15 and will be succeeded in Massachusetts by Stephen H. Smith, a former hydraulic engineer for the Stone



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& Webster organization, and recently chief engineer examiner of projects for the P.W.A. in the Bay State.

•

Birmingham Officials Take Office

Three officials of the Birmingham Electric Company who recently were promoted (ELECTRICAL WORLD, October 26, page 82) have taken office. C. S. Thorn, who was elected vice-president in charge of operation, has been identified with the Birmingham utility since 1927, when he was appointed assistant chief engineer. Two years later he was made chief engineer, the position he held until his

C. S. Thorn

recent promotion to a vice-presidency. Mr. Thorn is a native of Washington, D. C., and a graduate of Rensselaer Polytechnic Institute. He is a member of the American Institute of Electrical Engineers.

H. E. Cox, who was elected vice-president in charge of sales, has been associated with Birmingham Electric and predecessor companies since 1911. He served at first in the operating and construction department, subsequently as

H. E. Cox
Blackstone Studio

assistant chief engineer and then chief engineer and more recently as assistant general manager. A native of Alabama and a graduate of the Alabama Polytechnic Institute, Mr. Cox was connected for a time with the General Electric Company. He has been active in association work in the Southeast, having served as president of that division of the old National Electric Light Association.

G. W. McCracken, who was made chief engineer to succeed Mr. Thorn, became distribution engineer for the

G. W. McCracken

Birmingham utility in 1926 and three years later was named electric engineer. He is a member of the American Institute of Electrical Engineers.

OBITUARY

August F. Hockenbeamer

On November 11 A. F. Hockenbeamer, president of the Pacific Gas & Electric Company, died suddenly at his home in Berkeley, at the age of 64. He was an outstanding utility leader and contributed greatly to civic and industrial progress on the Coast. Back in 1914 Mr. Hockenbeamer originated the idea of customer ownership in the utility business and first applied it successfully by selling securities to his employees and local customers. In all circles his financial acumen and sound judgment were valued greatly and he took a keen and active interest in the development of the entire industry through his participation in its co-operative activities.

Mr. Hockenbeamer reached the heights of success through sheer merit. He was born in Logansport, Ind., on March 6, 1871, and spent his youth in this railroad town. He eagerly sought education and read widely despite the necessity of working in a store, selling newspapers and otherwise earning needed money. By the time he was 16 he had somehow learned stenography, but to land a job he was forced first to serve as a janitor, office boy, messenger and jack-of-all jobs for the Pennsylvania Railroad. Here he attracted the attention of L. F. Loree and by his ability, industry and ambition he rapidly advanced in the railroad business with Mr. Loree.

His mastery of the railroad industry and of utility finance attracted the attention of the investment house of Halsey & Company, which retained him as its utility expert in 1903. One of its investment clients was the Pacific Gas & Electric Company, and when Mr. Hockenbeamer visited the property he created such a favorable impression that P. G. & E. executives made him a tempting offer to act as comptroller, which he accepted. This was in 1907. Six months later he was made treasurer and within two years vice-president.

It was in 1914 that Mr. Hockenbeamer became imbued with the idea of junior financing through sales of securities to employees and customers. He believed this plan would insure a sense of common interest and co-operation in developing the business as well as afford a sound plan for raising the money necessary to expand the property. He introduced the plan and it was so successful that other utilities used it. Thus Mr. Hockenbeamer was the originator of customer ownership.

Upon the death of Wigginton E. Creed, in 1927, Mr. Hockenbeamer was made president, and under his leadership the company has grown and prospered. He had executive ability of a high order and developed his utility enterprise on a balanced and progressive plan that brought outstanding results. One of his most recent tasks was a large refunding financial operation that reduced interest obligations appreciably. In public rela-

A. F. Hockenbeamer

tions, engineering, operation, finance and sales his company earned and maintained a high place in utility ranks.

As a utility leader and as an outstanding public-spirited citizen of the Coast, Mr. Hockenbeamer's loss will be felt deeply. He leaves a record to which the industry and his associates may point with pride.

•

►CHARLES F. FARLEY, vice-president of the Kansas City Power & Light Company, Kansas City, Mo., died at his home in that city October 31. Mr. Farley had been associated with the Kansas City utility since 1905. He started in the sales department and subsequently became sales manager. In 1924 Mr. Farley was made a vice-president in charge of merchandise sales, incandescent lamps, credit and collection departments. He was 54 years of age.

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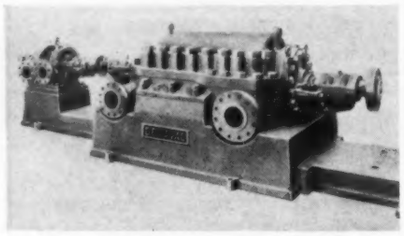
NEW EQUIPMENT

Boiler Feed Pump

Use of high steam pressures and temperatures in central stations has necessitated improvements in the design of boiler feed pumps. This high-pressure boiler feed pump, which has been successfully used at pressures up to 1,600 lb., and for temperatures around 300 deg., features the means employed to maintain axial balance. Thrust



Suction pressure 105 lb. per sq.in.; discharge pressure 880 lb. per sq.in.; capacity, 647 g.p.m. at 1,770 r.p.m.; used with two-stage booster pump. **De Laval Steam Turbine Co.**, Trenton, N. J.

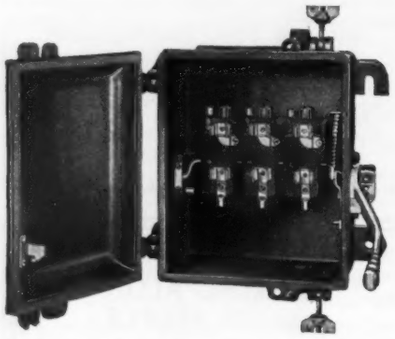
caused by high discharge pressures is toward the suction end of the pump and has been balanced by introduction of a radial leakage joint past a balancing disk keyed to the shaft back of the last impeller. Leakage past this joint is bled from the balancing chamber to the suction end of the pump.

General design is similar to the "Jaeger" type pumps. Single suction impellers are used. Individual diaphragms between stages are one-piece disks which contain the return passages to the eye of the next impeller and which fit into the recesses in the pump casing and cover. Leakage past the impellers is opposed by rings of the double labyrinth type. This type ring permits large running clearances without excessive leakage. The ample mechanical clearance made possible with these rings is said to be advantageous when dealing with high pressures and temperatures.

•

Industrial Safety Switches

Safety switches of this make, using the "dual-break," quick-make and quick-break mechanism of the type "A" switch, are available in weatherproof cast-iron cases. Applications for the switch are found in flour, steel and paper mills, breweries and chemical plants, where combustible materials are stored. Covers are bolted to the case and rubber gaskets used to provide a sealed fit. Dust-tight bearings are supplied for the operating handle.



Models rated up to 50 hp., both fused and non-fused. **Colt Patent Fire Arms Mfg. Co.**, Hartford, Conn.

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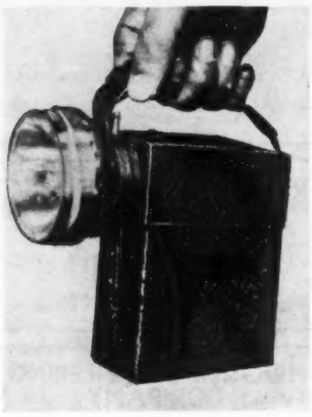
Emergency Lights

Light weight, portability, high beam candlepower and long burning hours are features of these emergency hand lights for trouble shooters and watchmen. Non-spillable, non-corrodible wet-cell batteries



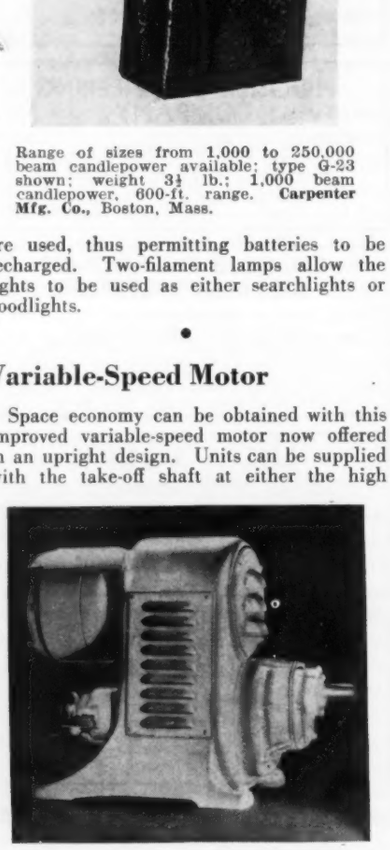
Range of sizes from 1,000 to 250,000 beam candlepower available; type G-23 shown; weight 3½ lb.; 1,000 beam candlepower, 600-ft. range. **Carpenter Mfg. Co.**, Boston, Mass.

are used, thus permitting batteries to be recharged. Two-filament lamps allow the lights to be used as either searchlights or floodlights.

•

Variable-Speed Motor

Space economy can be obtained with this improved variable-speed motor now offered in an upright design. Units can be supplied with the take-off shaft at either the high



"Varidrive." **U. S. Electrical Mfg. Co.**, Los Angeles, Calif.

or the low position as desired. As with the horizontal type, these units provide infinite variations in speed with either local or remote control.

Motive Power Battery

Used in industrial trucks and tractors, these improved motive power storage batteries employ laminated mats of spun glass to retain the active material in the positive units of the battery cell. These mats are said to prevent the active matter of the positive units from shedding. Extreme porosity of the mats makes possible large quantities of electrolyte adjacent to the active material. Additional features claimed are exceptional response to high current demand for starting and ability to deliver more than rated capacity during useful life.

Type KMD; sectional view of single cell shows, at bottom, negative plate, separator, perforated envelope, spun glass mat, positive unit. **Gould Storage Battery Corp.**, Depew, N. Y.

•

Calculator and Function Table

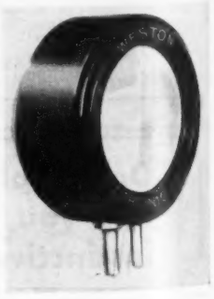
"Trignograph," cardboard or celluloid models available. **Chemical Rubber Publishing Co.**, Cleveland, Ohio.

Trigonometric functions can be graphically obtained with this chart, which consists of a movable hypothenuse attached to a basic 45 deg. right triangle, both of which are decimally divided. Moving the hypothenuse through an angle the chart will indicate to two or three places the ratios between the sides of the triangle. By using a unit length for a side of the triangle these ratios will be expressed as trigonometric functions.

•

High-Output Photronic Cell

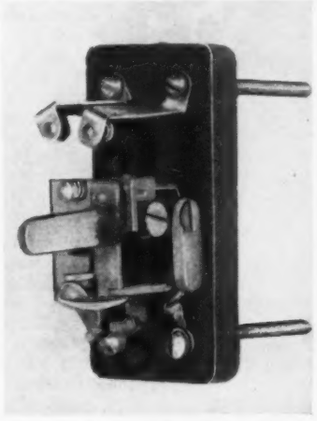
High current output obtained from this "dry plate" photronic cell makes it suitable for use on levels of illumination too low for proper operation of standard cells. The current output is about three times that of the regular cell for the same illumination. Although not as stable as the standard cell, it is said to be suitable where high output is more essential than strict performance.



Designated as Type 2 photronic cell. **Weston Electrical Instrument Corp.**, Newark, N. J.

Manual Reset Relay

When used in signal circuits this relay permits operators to disconnect the signal and yet have the circuit return to normal when the signal has passed. With back contacts normally open when energized, failure of power closes the contacts setting



Shown with cover removed. **Struthers Dunn, Inc.,** Philadelphia.

off the alarm. Operation of the reset lever disconnects the alarm by latching the contacts open. When power is restored the relay armature picks up and locks the contacts open, allowing the reset lever to return to the normal position.

•

Low-Wattage Resistors

Ratings, 1 watt in sizes from 300 ohms to 10 megohms; ½ watt in sizes from 100 to 5 megohms. **International Resistance Co.,** Philadelphia, Pa.

Designed for the more exacting electrical requirements, these low-wattage resistors are fully sealed and covered with high-voltage insulating material to seal out moisture and prevent short circuiting by contact with live parts. Other features claimed are low noise level, accuracy and permanency of resistor characteristics. Improved metallized resistance elements are used.

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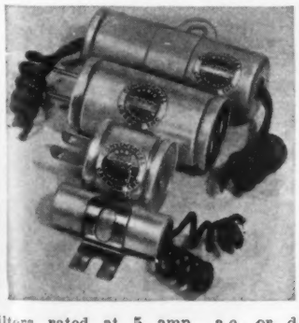
Interference Filters

Filters in the seven-item line of "Filtercons" are designed for use with small motors, heater pads, vibrators and neon transformers and are of the type which prevents radiation of high-frequency impulses



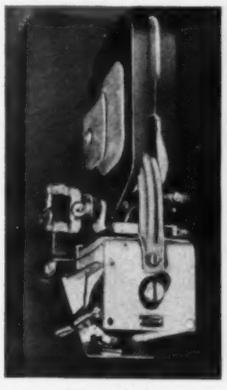
Filters rated at 5 amp., a.c. or d.c.; seven types available. **Continental Carbon, Inc.,** Cleveland, Ohio.

on the supply lines. Two designs are specifically for use between a radio receiver and a power line and are of the convenient plug-in type which can be quickly connected and demonstrated. For oil burner motors and noise-reducing devices with grounded frames two filters are provided with mounting straps to be attached directly to the apparatus. Five of the seven filters employ combination network of inductances and condensers.

•

Heavy-Duty Contactors

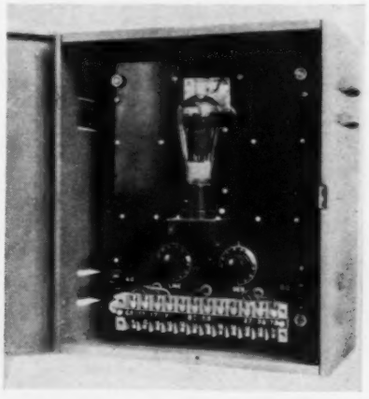
Designed to reduce maintenance costs, these d.c. contactors are intended for heavy-duty service where continuous operation is an essential factor. Rocker bearings are employed to minimize the effect of wear. All frames are adapted for mounting mechanical and electrical interlocks so that these devices can be added after installation. The heavy copper tips used are cadmium plated and are of sufficient size to handle inrush currents without excessive heating.



Ratings of 150, 300, 600, 1,500 and 2,500 amp., d.c.; for normally open or normally closed operation. **General Electric Co.,** Schenectady, N. Y.

Angle Switching Equipment

This device is used for controlling large synchronous motor-driven reciprocating pumps and compressors to prevent the compression strokes on different machines occurring in unison. Employing an electronic tube, this new device reduces the magnitude of current pulsations where two or more drives are used. Minimum pulsations are desirable to reduce flicker in lights and interference with the operation of other electrical equipment.



Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

Design and construction features of distribution transformers are graphically depicted in Allis-Chalmers bulletin 1173.

A group of four folders now available from the Worthington Pump & Machinery Company, Harrison, N. J., tabulate the features of each of a line of four gasoline-engine-driven portable compressors. Specifications of both compressor and power unit are given, together with dimension and weight data.

Five engineering papers discussing service of poles and pole lines are now available from the International Creosoting and Construction Company, Galveston, Tex. They are: (1) Termites—Destroyers of Wood—Man's Fight Against Them, (2) An Improved Roof for Poles, (3) Preservative Treatment and Line Service of Creosoted Pine Poles, (4) Cities Using Creosoted Poles in Residential Areas, (5) Ultimate Fiber Stresses in Wood Poles.

A new weatherproof line wire is described in General Electric bulletin GEA-2103. Advantages, construction, over-all finish, field of application and specifications are detailed.

Data on uses and properties of various bronze alloys have been assembled by Joseph T. Ryersen & Son, Inc., Chicago, in their 26-page booklet on "Permite" 6-ft. cast bronze bars. Such subjects as wear resistance, coefficient of friction, machinability, tensile strength and hardness of many alloys are discussed.

Applications of Automatic Voltage Boosters is the title of General Electric publication GEA-2028. The eight-page leaflet is a study of problems encountered in regulating voltage on lightly loaded feeders. The text is amply illustrated by voltage charts and records.

Pyranol capacitors used for improving power factor at signal locations are the subject of a new General Electric bulletin (GEA-1584C). Its eight pages are devoted to a discussion of installation, maintenance, characteristics and selection of the capacitors and the effect of frequency and voltage on their operation.

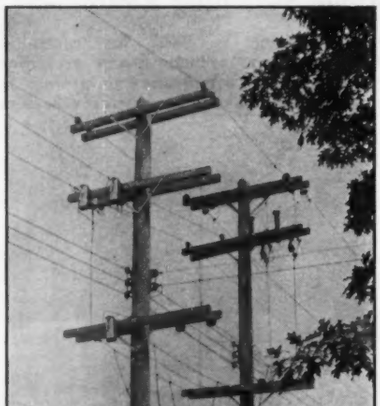
"Zeolites, their mining, processing, manufacture and use" is a 28-page booklet available from the Permutit Company, 330 W. 42d St., New York City. It describes the disadvantages of hard water and the use of zeolites in order to overcome these disadvantages.

"Dilecto," a laminated, phenolic material produced by Continental-Diamond Fibre Company, Newark, Del., is described in a 46-page illustrated bulletin available from that company. Properties, manufacture and application of Dilecto are discussed and illustrated. A two-page table compares its properties with those of other similar materials.

The story of high-voltage transmission from Boulder Dam to Los Angeles is told pleasantly in non-technical language in an illustrated booklet which is announced by the General Cable Corporation, New York City.

The basic principles of armored "Kathanode" storage batteries are explained and assembly and application details described in a two-page leaflet (bulletin No. 962) of the Gould Storage Battery Corporation, Depew, N. Y.

"Data Book for Lamp Purchasers," available from Wabash Appliance Corporation, 335 Carroll Street, Brooklyn, N. Y., answers questions commonly asked about lamp quality, efficiency, burning life, guarantees, tests, voltages, etc., in addition to listing the complete line of "Waco" lamps.



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Westinghouse

The New

BR BOOSTER

Let's Not Make the Same Mistake Twice

[*Continued from page 27*]

The new approach to lighting sales is not a device merely to increase current consumption; it is a program to increase human efficiency, human happiness and an appreciation of what electricity really means in terms of service. There is nothing maudlin in this point of view. Its truth has been proved most abundantly by the Better Light-Better Sight activities of many utilities. It has been accepted and is being promulgated by the optical profession. By selling *adequate* lighting in the first instance to the new rural customer you not only immediately place him on the profit side of the ledger, but you render him the maximum service at the minimum investment. An adequately lighted barn will cut an hour off the day's chores of the farmer; an adequately lighted kitchen will cut an hour off the good wife's kitchen puttering; adequate light in the living room may easily save the children doing "home work" from flunking a term or two during their school days and add a year of usefulness to their lives.

Our past mistake was that of measuring expansion in terms of meters connected, then in terms of kilowatts connected, then in terms of merchandise sales, but never in terms of human service rendered. Light is the fundamental human service which electricity can render, the luxury of cleanliness is the next closely following service, true labor saving is the third, and finally come the luxury services—refrigeration, cooking, water heating and the myriad conveniences which are the fortunate heritage of the better-to-do. That is the order in which electric service should be sold, and if sold in that order to rural customers it will be profitable to both the utility and these customers from first day to last.

But our argument is all predicated upon *adequacy* of lighting, which is where we formerly fell down. For in the previous customer boom we sold raw cheapness, and raw cheapness is no better in the customer's home than it is in the power house or on the executive salary roll. You wouldn't trust your output to cheap equipment; you wouldn't trust your management to cheap executives; then why trust your income to cheap wiring, cheap appliances and cheap lighting?

The question answers itself.

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NORRISTOWN, PA.

Recent Rate Changes

Nebraska Power Company has announced a reduction in electric power rates that will save users in Omaha, Council Bluffs and the surrounding area $500,000 a year. The reduction will be effective January 1 and residential users will be the largest beneficiaries. The residential rate will be cut from 5½ cents for the first block to 4¾ cents; the 5-cent block of the general rate for commercial lighting will be reduced to 4¾ cents; the 5-cent block of the present small power rate will be reduced to 4¾ cents and rates for larger power customers will be rearranged in a manner beneficial to such customers.

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Hartford Electric Light Company's customers can now obtain the bulk of energy used for home service in the form of heat and mechanical power for less than 3 cents per kilowatt-hour, according to a statement by Samuel Ferguson, chairman of the board. This compares favorably with rates established by the Tennessee Valley Authority, Mr. Ferguson said. On December 1 a new "electric home rate" will be set up which will provide a reduction of about $130,000 in the revenues of the company under present schedules, and there will also be a reduction of about $40,000 in a revised domestic schedule applying to customers who are not eligible to receive the "electric home rate" by reason of increased usage. The present average rate is 4.02 cents per kilowatt-hour. The new "electric home rate" reduces the 3-cent block in the present schedule to 2.85 cents, and it will lower the bills from small amounts on small usage to $1.25 per month in cases of liberal usage. It will be available to all who in the present year have made a material increase in the usage of electricity over 1934 monthly figures, to all who in future make a material increase over the 1934 usage and to all who have or will have homes using electric lighting, refrigeration, cooking and water heating. Mr. Ferguson stated that the company's bogey is 1,200 kw.-hr. per year per residential customer by 1937.

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Conowingo Power Company has filed proceedings against the Maryland Public Service Commission in the Circuit Court in Baltimore, asking that an injunction order be issued and that the court declare confiscatory and unconstitutional the $45,000-a-year rate reduction order by the commission. Judge Joseph N. Ulman signed orders giving the commission until December 3 to show cause why an injunction should not be issued.

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Union Light, Heat & Power Company's revised schedule of residential, commercial and power rates has been approved by the Kentucky Public Service Commission. The schedule calls for an annual reduction of $20,000 to Covington consumers, $3,000 to Bellevue, $8,500 to Newport, $2,500 to Dayton and $2,000 to Ludlow.

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Rhode Island Utilities Division will investigate all the electric power companies in the state, according to a statement made by Commissioner F. A. Young, provided $203,880 of the $230,000 fund for the investigation can be obtained from the federal government as a W.P.A. project. The application has been pending at Washington since last summer. Governor Green has approved the transfer of $26,120 from the state treasury as Rhode Island's share of the cost. The objective is to fix a rate base. The commissioner has been making cost analyses of the Narragansett Electric,

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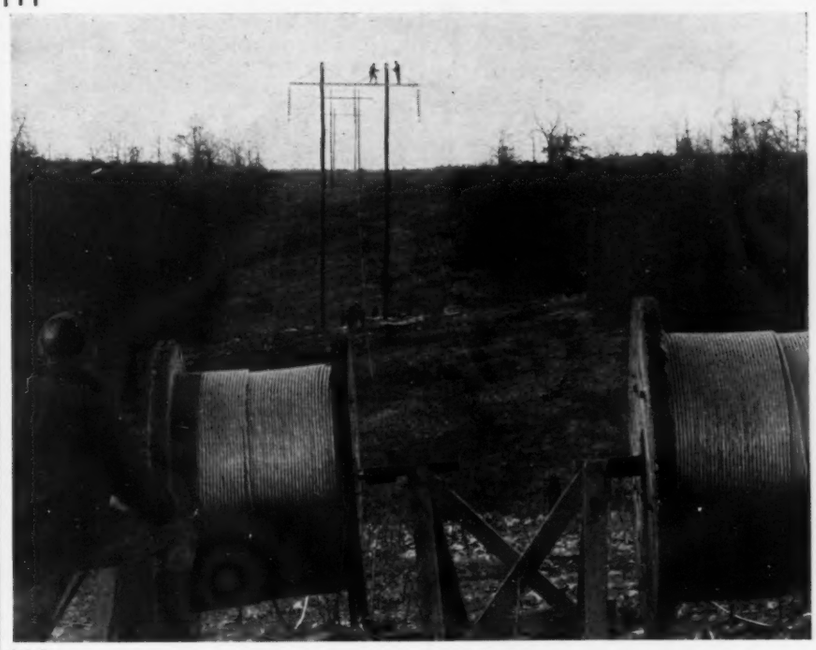

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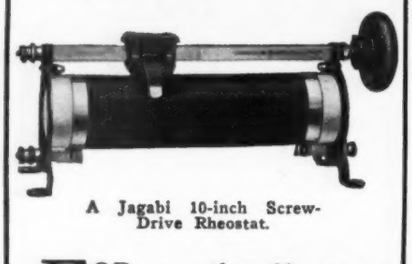

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Blackstone Valley Gas & Electric and Newport Electric systems to establish more acceptable accounting methods and has recommended that the powers of the division be enlarged to include jurisdiction over security issues, inter-utility contracts, mergers and reorganizations. In a recent statement he asserted that rate savings exceeding $500,000 have resulted on a per annum basis since the division was organized last spring.

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Georgia Power Company has been called upon by the state Public Service Commission to show cause why its industrial rates should not be reduced. A rule *nisi* has been issued against the company upon the complaint of several textile mills which are large users of power in the industrial rate bracket.

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Arkansas State Department of Public Utilities in an order issued November 1 characterized the residential rate structure of the company, built around service charges based on the number of rooms in the customer's house, as an "unjustifiable discrimination." The order and report, relating to the low cost rate program, instituted by the department several months ago, directed the company: (1) To eliminate the "per room" feature of its service charge; (2) to put into effect January 1 immediate rate reductions totaling $293,000 a year on residential and commercial service; (3) to install an objective rate, which the company requested be designated the "centennial rate," designed to save customers $372,000 a year if the present rate of increased usage continues. The order provides that the "centennial rate" shall apply exclusively to all customers when 50 per cent of the bills for any year shall be for 35 or more kilowatt-hours per month. It was stressed in the order that the immediate and objective rates prescribed by the order are not the result of a full and complete investigation of the company's rate structure and that these rates will be subject to change when the department completes an audit, inventory and investigation of the company's assets, revenues and expenses. Similar immediate reductions and objective rates will be ordered for other major companies as rapidly as proposed schedules submitted by the companies can be checked and prepared in final form.

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Northern States Power Company will put into effect January 1 an approximate 25 per cent reduction in farm electric rates.

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Nebraska Supreme Court held that the existing laws do not limit the power of the railway commission in the fixing of rural electric rates to those cases where a physical connection has been ordered by the commission, but that the law of 1925 confers upon the commission jurisdiction, upon application of consumers, to hold hearings and determine what are reasonable rates for service to users along the transmission lines of companies engaged in generating and transmitting electric energy for sale. The case originated in the complaints of patrons of the Iowa-Nebraska Light & Power Company, who said they were charged more than was reasonable for service, and requested the commission to fix rates. The case was an agreed one for the purpose of testing the power of the commission to fix rural rates, and now that the court has held the commission has jurisdiction a hearing will be held upon the question of reasonableness of rates charged.

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Pacific Gas & Electric Company's new rate schedules (ELECTRICAL WORLD, November 9, page 97) have met with opposition from certain communities in northern California, including Palo Alto and Alameda. The new schedules filed with the Railroad Commission listed reductions, ranging up to 20 per cent, for direct users, but no reductions for the cities with their own distribution systems. Representatives of municipal distributors declared it was discriminatory to leave their wholesale rates at present levels.

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Kentucky Public Service Commission's jurisdiction in fixing rates for local public utilities is being challenged by the city of Louisville. In a general statement dealing with the subject Mayor Neville Miller said: "I believe that responsibility and power to fix and adjust utility rates should rest as a matter of fundamental principle primarily in the city itself. This is true especially in the case of a large city like Louisville, able to make its own investigations and in constant contact with local conditions, which local conditions many times differ very materially from conditions elsewhere in the state. Apart from sound municipal policy, the city actually has the right to fix rates."

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Municipal Items

OCHEYEDAN, IOWA—Northwestern Light & Power Company recently had a new twenty-five year franchise voted to it by 123 to 41.

HEPLER, KAN.—City has elected to sell its distribution system to the Kansas Gas & Electric Company. The municipal plant itself will be disposed of later.

PHILLIPSBURG, KAN.—Kansas Power Company has requested an injunction in District Court against the city, to prevent construction of an electric plant with P.W.A. funds. The petition alleges that the election on September 26 approving a bond issue was illegal.

SENECA, KAN.—City officials have declined a grant of $37,636 and a federal loan of $46,000 from the P.W.A. for the construction of a municipal plant. A five-year contract for electric service, effective January, 1936, has been entered into with the United Power & Light Corporation, which heretofore has served the city.

WILLIAMSTOWN, KY.—In the November 5 election citizens, by a vote of 506 to 361, refused to finance the proposed municipal electric light plant.

BILOXI, MISS.—W.P.A. has turned down an application for loans to construct a municipal distribution system.

KIRKSVILLE, MO.—P.W.A. has allotted the city a $288,000 grant and $352,000 loan to finance the construction of a municipal light and power plant complete with equipment and auxiliary appurtenances. Plans are being prepared by Black & Veatch, consulting engineers of Kansas City, Mo., and it is anticipated that construction bids will be taken at an early date.

FREMONT, NEB.—As the result of an increased load, which jumped 10.5 per cent during the last three months, the municipal plant has reduced its rates. Rates start at 4½ cents per kilowatt-hour for the first 50 kw.-hr. and drop to 1 cent per kilowatt-hour for users of more than 100 kw.-hr. The former rates ranged from 5 to 1½ cents. Commercial rates will range from 4½ cents for the first 100 kw.-hr. to 1½ cents for any excess more than 2,000 kw.-hr. Power rates are 4½ cents for the first 100 kw.-hr. to 1½ cents for the excess over 20,000.

ALBANY, N. Y.—On November 5 citizens approved a proposal to authorize the creation of an Albany City Power authority which would have the right to issue $10,000,000 bonds and go into the business of supplying electricity for light, heat and

power. At the same time a second proposal empowering the county of Albany to create a county power authority and engage in similar business and issue $10,000,000 bonds was also approved. If both proposals should be carried out this would mean that the county could set up an authority and operate in the city of Albany and compete with a plant which the city would establish.

LOCKPORT, N. Y.—On November 5 citizens voted not to build a municipal power plant, defeating the proposal 4,592 to 3,516.

GRAND FORKS, N. D.—District of Columbia Supreme Court has issued a restraining order against a $472,000 loan and grant by P.W.A. for a municipal electric plant. The Northern States Power Company, complainant, claims that an investment of $950,000 is jeopardized and that construction of a municipal plant would prevent it from serving nine surrounding communities.

READING, OHIO—Proposal to sell the municipal light plant to the Union Gas & Electric Company was defeated in the recent election by a vote of 2,227 to 336.

LEWISBURG, TENN. — Citizens recently voted 465 to 5 in favor of a bond issue of $53,000 for a municipal distribution system, looking to the eventual completion of a contract for T.V.A. power. Plans for the distribution system call for the expenditure of $100,000, the remaining $47,000 to be furnished by the P.W.A. under terms of an agreement already approved.

TEXARKANA, TEX. — Modification has been made by Judge Randolph Bryant of the Federal District Court of the temporary injunction which restrained the city officials from proceeding with its application for a loan and grant of $872,000 from the P.W.A. for the construction of a municipal electric light and power plant (ELECTRICAL WORLD, November 9, page 99). The modified order permits the city to proceed with the application up to the point of signing the contract. The injunction was obtained by the Southwestern Gas & Electric Company, which supplies the city.

BENTON COUNTY, WASH.—Elections for forming power districts may be financed by warrants issued on contemplated revenues, provided the district has not available funds, Attorney-General G. W. Hamilton ruled in a recent decision. Benton County had asked for an opinion. Attorney-General Hamilton said that the county election board is obligated to call the election and must apportion the expense against the various districts. "A power district is a taxing district," he said, "and warrants can be issued against it whether or not there are any funds to its credit for mandatory expense. Warrants can be paid off when money is raised by taxation in the district."

SPOKANE, WASH.—City commissioners have formally accepted a federal grant of not to exceed $193,500 as the P.W.A. donation toward construction of the proposed $650,000 up-river hydro-electric plant.

RACINE, WIS.—Mayor William J. Swoboda has ordered a survey to determine the possibilities and advantages of a municipally owned light plant for the city.

BOONEVILLE, N. Y.—Public Service Commission exceeded its delegated powers and cannot be sustained, the Appellate Division, Third Department, held last week in annulling the determination of the commission fixing rates for the municipal electric plant. The order, which is sent back to the commission for future action, reduced rates charged by the Boonville plant by $15,000. The commission contended that the plant was earning $10,000 a year and was turning it over to the village for the reduction of taxes. The village contended that it had the same right to charge rates which would yield the same return as privately owned public utilities.

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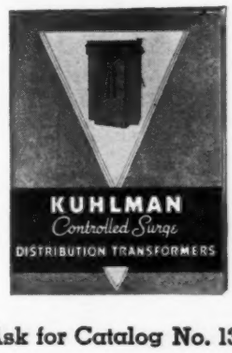

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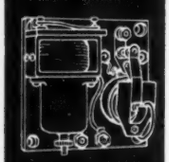

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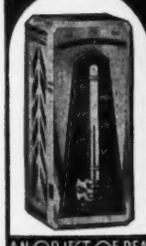

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